electrical contracting

Maintenance Section

PAGES 151-158

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APRIL • 1939 ONE DOLLAR

ENGINEERING • INSTALLATION • MAINTENANCE

Electrical Specifications

IN THIS ISSUE

How to Plan the Wiring System and Write Specifications for Residential, Commercial and Industrial Buildings . . . Manufacturers' Exhibit Section

WHO'S AFRAID of the BIG BAD SHORT CIRCUITS NOW?

IT'S a G-E AIR BREAKER WITH PLENTY OF "IC"

"I C" = Interrupting Capacity

G-E AIR CIRCUIT BREAKERS have the necessary interrupting capacity to protect your men and equipment. The famous "arc quencher" breaks up the most threatening arcs into countless small bits.

These breakers do more than protect. They minimize production delays. Service can be restored immediately by the turn of a handle. There are no parts to be replaced.

They also provide three-phase interruption.

Wise operators are installing them on all branch circuits where the adequacy of the "I C" is under suspicion. For main circuits, General Electric offers its popular factory-assembled, metal-enclosed switchboard with draw-out-type air breakers.

If you have any question about how to determine the interrupting capacity needed, in order to know the size of circuit breaker to use, get in touch with the nearest G-E office.

THE severity of a short circuit depends largely on the capacity of the transformers that feed the circuits, and it can *not* be determined by the normal load on the circuit. As plant loads have grown, transformer capacities have been materially increased. Therefore, short circuits present an ever-increasing hazard. They gravely endanger personnel and property wherever the power supply has outgrown the interrupting capacity ("IC") of the protective devices. Are you sure of your "I C"? With G-E air circuit breakers of *known* interrupting capacity, you *can* be sure.

G-E AIR CIRCUIT BREAKERS ARE AVAILABLE WITH INTERRUPTING RATINGS UP TO 80,000 AMPERES

GENERAL ELECTRIC

890-81

There's a profit in every foot

ORANGEBURG NOCRETE *the new Dual Economy* CONDUIT

For use underground without concrete encasement

- **NOCRETE** Conduit assures savings in material costs—is about half the cost of metal pipe and less than non-metallic conduits of any comparable quality. Ask our representative for prices. All types of fittings, ells, bends, etc. are available.

- **NOCRETE** "handles easy;" light in weight, this super-sturdy duct will surprise you by its adaptability. It assembles and installs easier, faster and at a lower cost than any conduit you have ever used. It is readily cut and fitted with ordinary wood-working tools.

Wherever electrical raceway facilities are to be installed underground, two specifications will cover every requirement:

Specify **"ORANGEBURG NOCRETE"** for installation *without* concrete encasement, for service entrances, extensions, parkways and street lighting, suburban services, laterals, signal systems, etc.

Specify **"ORANGEBURG *STANDARD*"** for installation *with* concrete encasement, for duct banks (4 ducts and over), main distribution, high tension and "downtown" underground etc.

Write us for detailed specifications NCS2 covering both lines.

By specifying **ORANGEBURG NOCRETE** or **ORANGEBURG *STANDARD*** for installation underground you will be assured that every foot of conduit and every fitting will give permanent cable protection and service.

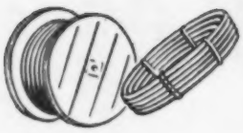
THE FIBRE CONDUIT COMPANY

Sales Office: **292 Madison Ave., New York**

Factory: **Orangeburg, N. Y.**

Sales Agent—Distributors:
The Graybar Electric Co.
General Electric Supply Corp.

ORANGEBURG

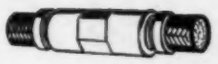


WIRES, CABLES AND CORDS

All kinds of wire and cable for every type of use. More than 90 different types of cable, wire and cords in all capacities and sizes. Graybar's reputation for quality assures dependability.

SWITCHES AND WIRING DEVICES

Time switches, safety switches, wall switches. . . . A wide selection of switches and wiring devices for industry, commerce and home (all sizes and capacities) is available from Graybar.



SOLDER AND SOLDERLESS FITTINGS

Solder fittings from Graybar are time tried. Solderless connectors, reducers and cable taps of all types, for both standard and special installations, are also conveniently available.

MOTORS AND CONTROL

All types of motors, ¼ to 200 H.P. Complete control equipment. G. E. motors from Graybar can be had to supply any power need. Call on Graybar to help you.

VENTILATING EQUIPMENT

Fans, blowers, and coolers for all purposes. Roof and kitchen ventilators. All sizes, and capacities. Let Graybar specialists advise you on your ventilation needs.

LAMPS AND LIGHTING EQUIPMENT

A complete line of lamps, lighting fixtures, glassware and accessories for Commercial, Industrial, Institutional, Floodlighting and Municipal (Street Lighting) needs.

CLOCKS

Electric clocks for home, office, industry. Self-winding adjustable program clocks (master and secondary) for school and industrial use.

FIRE-ALARM EQUIPMENT

Industrial, school, residence, and municipal fire-alarm apparatus. A complete line . . . including boxes, batteries, rectifiers, horns, etc.

PUBLIC ADDRESS EQUIPMENT

Complete Western Electric sound systems for Schools, Amusement Parks, Hotels, Newspapers, etc. Also for Industrial and Railroad use.

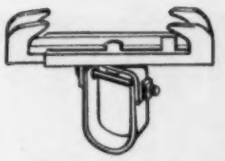
OFFICES IN 83 PRINCIPAL CITIES • EXECUTIVE OFFICES: GRAYBAR BUILDING, NEW YORK, N. Y.

FUSES AND CIRCUIT BREAKERS

Graybar offers you a complete line of fuses . . . knife blade, cartridge and plug types . . . to meet every fuse requirement. A wide selection of circuit breakers for every need is available.

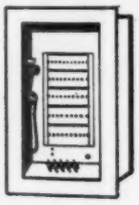
CONDUIT AND RACEWAYS

All kinds. Metallic—thin wall and standard. Underfloor conduit. Fibre conduit. Clay conduit. You'll find a wide variety of types and sizes for every use available through Graybar.



CONDUIT FITTINGS AND BOXES

All kinds of fittings, bushings, clamps, etc., for every type of raceway. A complete selection of all sizes and capacities to meet your requirements. Ask your Graybar salesman for details.

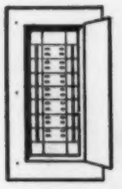


SWITCHBOARDS

For Power, Lighting, Signaling (Inter-Phone). Advise us on your requirements. We will gladly submit figures and information on our product to meet your needs.

INTER-COMMUNICATING SYSTEMS

Selective Ringing—Selective Talking; Selective Ringing—Common Talking; Common Ringing—Common Talking Inter-Phone Systems. Loud speaking systems to meet your needs.



PANELS AND PANELBOARDS

All types and capacities for Lighting or Power. Practically any panelboard need can be quickly met . . . for Industry, Homes, Apartments, Stores, Schools, etc.

NURSES' AND DOCTORS' CALL

Complete hospital signaling and paging systems and equipment. Approved by Underwriters'. Graybar specialists will gladly help you.

FRICTION AND RUBBER TAPE

Tape to meet every need, from A. S. T. M. to special H-P Waterproof outdoor tape. Tell us your needs, we can furnish the right tape.

INSULATING MATERIAL

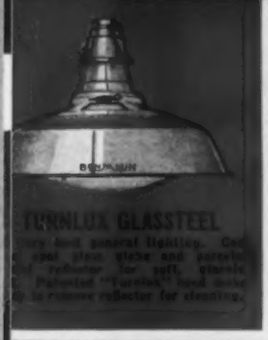
Mica, Micanite, Lamicoid, Micoid and Fibre, Cloths and Tapes (varnished and unvarnished). Other insulating items are available.

IN 1869 GRAY & BARTON
70th ANNIVERSARY
GraybaR
ELECTRIC COMPANY
IN 1939 GRAYBAR

OFFICES IN 83 PRINCIPAL CITIES • EXECUTIVE OFFICES: GRAYBAR BUILDING, NEW YORK, N. Y.

BENJAMIN

HEADQUARTERS FOR INDUSTRIAL LIGHTING

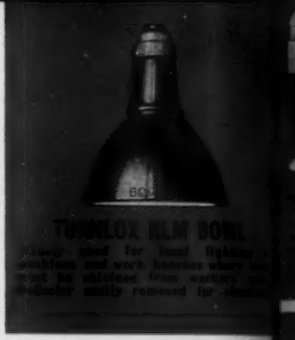


TURNLOX GLASSTEEL

TURNLOX RLM DOME

TURNLOX SHALLOW DOME

TURNLOX FLAT CONE



TURNLOX RLM BOWL

SILVER BOWL DIFFUSER

TURNLOX ELLIPTICAL ANGLE

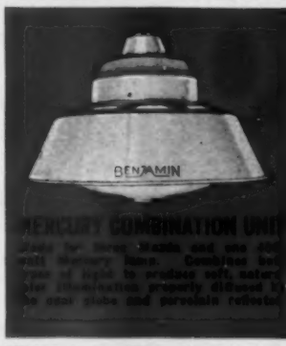
TURNLOX RLM ANGLE

ALZAK HIGH BAY UNITS

LUMINOUS TOP DIFFUSER

MERCURY DOME

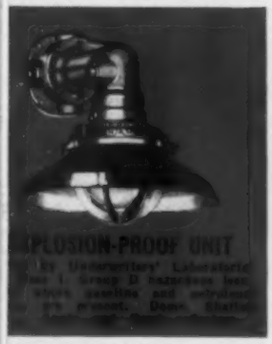
250-WATT MERCURY DOME



MERCURY COMBINATION UNIT

MERCURY COMBINATION UNIT

MERCURY HIGH BAY UNIT

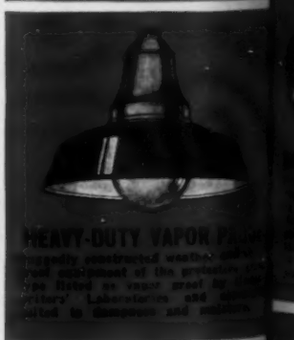


EXPLOSION-PROOF UNIT

DUST-TIGHT FIXTURES

VAPOR-SEAL REFLECTOR

INDUSTRIAL VAPOLETS



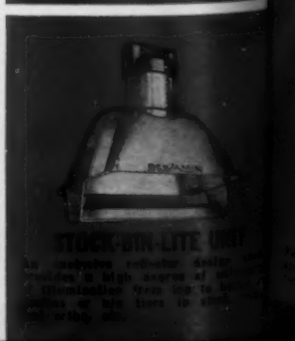
HEAVY-DUTY VAPOR PROOF

"DAYLIGHT" FLUORESCENT

SKYLIGHT FIXTURE

EQUALITE BOWL REFLECTOR

EMBLEM SIGN REFLECTORS



STOCK-BIN-LITE UNIT

BENJAMIN ELECTRIC MFG. COMPANY

BENJAMIN

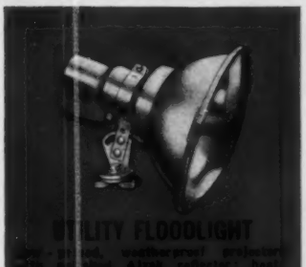
HEADQUARTERS FOR FLOODLIGHTS & SIGNALS

"ELLIPTO-LITE" FLOODLIGHT

LONG-RANGE FLOODLIGHT

"ALZO-LITE" FLOODLIGHT

FLOODLIGHT PROJECTORS



UTILITY FLOODLIGHT

UTILITY FLOODLIGHT

PORTABLE FLOODLIGHT

COLUMN-LITE FIXTURE

KODE-KALL

MOTOR-DRIVEN SIGNAL

INDUSTRIAL SIRENS

WEATHERPROOF HOWLERS

NON-WEATHERPROOF HOWLERS

PROJECTOR HOWLER

PROJECTORLESS HOWLER

SINGLE-STROKE CHIME

EXPLOSION-PROOF RELAY

INDUSTRIAL BUZZER

INTENSIFIER SPOTLIGHT

PROJECTOLITE SPOTLIGHT

SINGED DUST TIGHT COVER

PIT AND TUNNEL UNIT

MASTER SIGN REFLECTOR

For Complete Information on These Units and Benjamin's Complete Line

SEND FOR FREE CATALOG

It's time to dust off

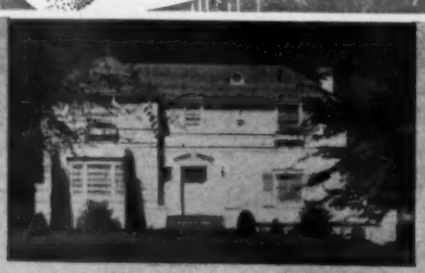
SPECIFICATIONS

Electrical conductors shall be enclosed in ELECTRUNITE Steeltubes conduit, as manufactured by STEEL AND TUBES, INC., Cleveland, Ohio, sizes 1/2 to 2 in., inclusive. Tubing shall be made from S.A.E. 1010 specification, cold-rolled, open-hearth strip steel, galvanized, and manufactured in accordance with Underwriters' Laboratories Standards, and so labeled.

ELECTRUNITE Steeltubes shall have electrically welded seams and shall be installed in accordance with the regulations of the National Electrical Code.

Watertight compression couplings and box connectors shall be Underwriters' approved type and so listed.

Small homes need adequate wiring, too. This one is wired in ELECTRUNITE Steeltubes.



This fine California residence is completely wired in ELECTRUNITE Steeltubes.

A famous broadcasting station in which 75,000 feet of ELECTRUNITE Steeltubes was used.

your "Specs"

● Not long ago, an architectural engineer made this comment: "When electrical metallic tubing first came out, I was as opposed to it as anyone I know—but I've been watching it for several years. I've tried it on a few recent jobs. I've checked various installations. Yesterday, I took my little black book and dusted off the conduit section to make the first change in years. I've decided that Steeltubes has earned and deserves a place in our specifications."

Consider the many advantages of ELECTRUNITE Steeltubes—the original electrical metallic tubing: tough, strong, abuse-resisting, open-hearth steel; fireproof, waterproof and tamperproof; light in weight—easy to handle and install; requires less room in concrete slabs and partitions; a continuity of corrosion-resisting galvanizing unbroken by cut threads; cost which places a steel-protected "pull-in—pull-out" system within the financial ability of everyone; full approval.

Use the recommended specifications at the left as a guide to better wiring.

Steel and Tubes, *Inc.*

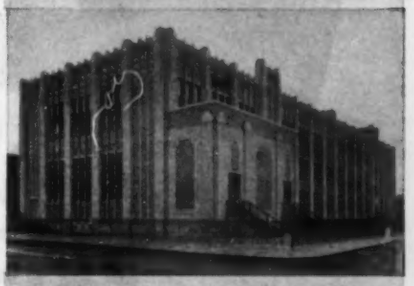
CLEVELAND . . . . OHIO

SUBSIDIARY: REPUBLIC STEEL CORPORATION

Look for this label. It is found only on genuine ELECTRUNITE Steeltubes—the pioneer electrical metallic tubing.

185,000 feet of ELECTRUNITE Steeltubes was used in wiring this mid-western bank building.

This electic utility power plant is wired in 45,000 feet of ELECTRUNITE Steeltubes.



75,000 feet of ELECTRUNITE Steeltubes protects the wiring in this eastern elementary school.

A New Jersey Theatre—18,000 feet of ELECTRUNITE Steeltubes, part of it in concrete slab construction.

350,000 feet of ELECTRUNITE Steeltubes was used in completely wiring this large industrial plant.

A modern, air-conditioned, Chicago department store—83,000 feet of ELECTRUNITE Steeltubes installed.

DOUBLE

FOR

NON-RAVELING
STRAIGHT TEARING
HIGH TENSILE STRENGTH
HIGHLY INSULATING
STRONG ADHESION

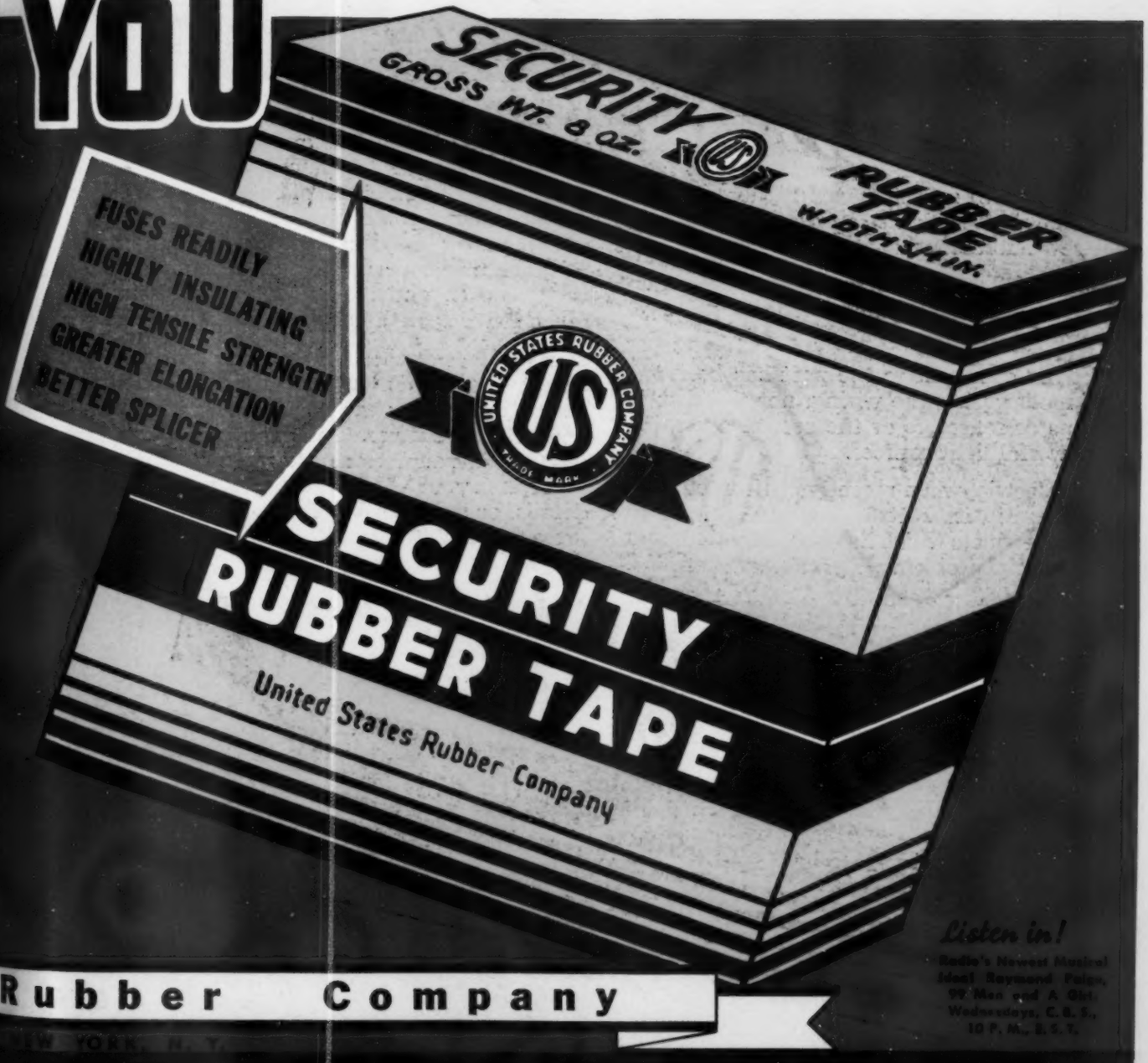
UNITED STATES RUBBER COMPANY
US
TRADE MARK

United States

ALSO MANUFACTURERS OF

SECURITY

YOU



Listen in!
Radio's Newest Musical Ideal Raymond Paige, 99 Men and A Girl, Wednesdays, C. S. T., 10 P. M., E. S. T.

Rubber Company

NEW YORK, N. Y.

ELECTRICAL WIRES AND CABLES

HERE'S A NEW, EASY WAY to Improve Your Lighting at Materially Lower Costs

IT'S recognized as excellent management, these days, to improve industrial lighting—using incandescent lamps of higher candlepower in new and modern reflectors, the highly effective G-E mercury-vapor light sources, or the sensational new fluorescent lamps.

It's a proved fact that better lighting speeds up production, improves quality, reduces spoilage, and steps up morale.

But the big deterrent in the past has been the cost of modernizing the wiring, not the cost of the lamps or reflectors or the cost of operating more powerful light sources.

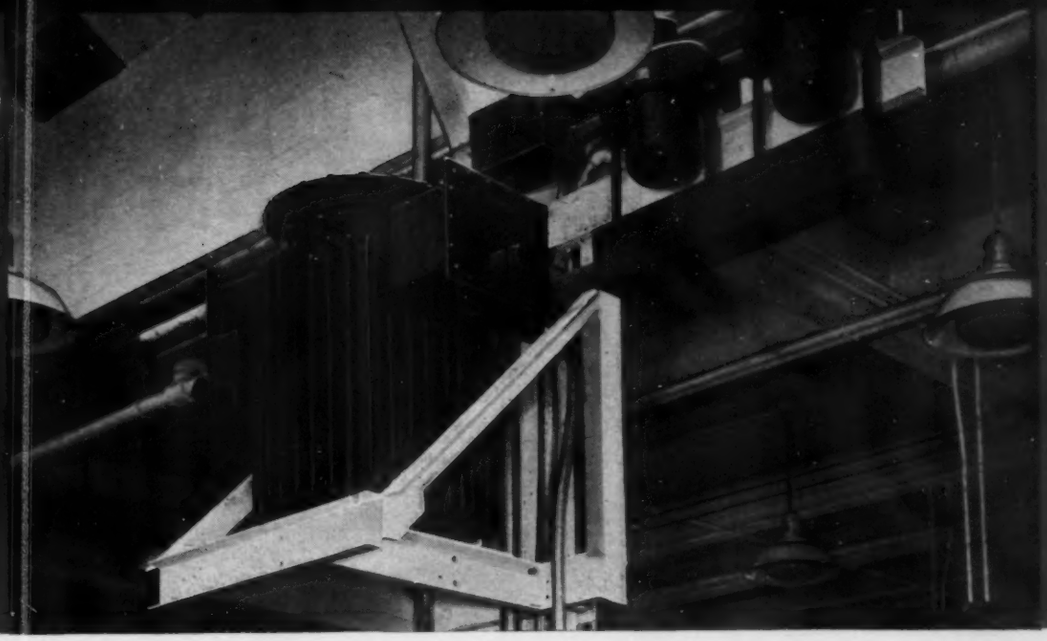
General Electric, when recently confronted with this problem in its Pittsfield works, turned to one of its products which has been solving many other industrial problems—Pyranol transformers.

Because Pyranol, the liquid in these transformers, is noninflammable and nonexplosive, the transformers can be placed anywhere in the factory, without a fireproof enclosing vault. This meant that we could divide the existing lighting circuit into several short sections, install a small Pyranol transformer near the ceiling to serve each section, and modernize the lighting at a much lower cost than by any other method.

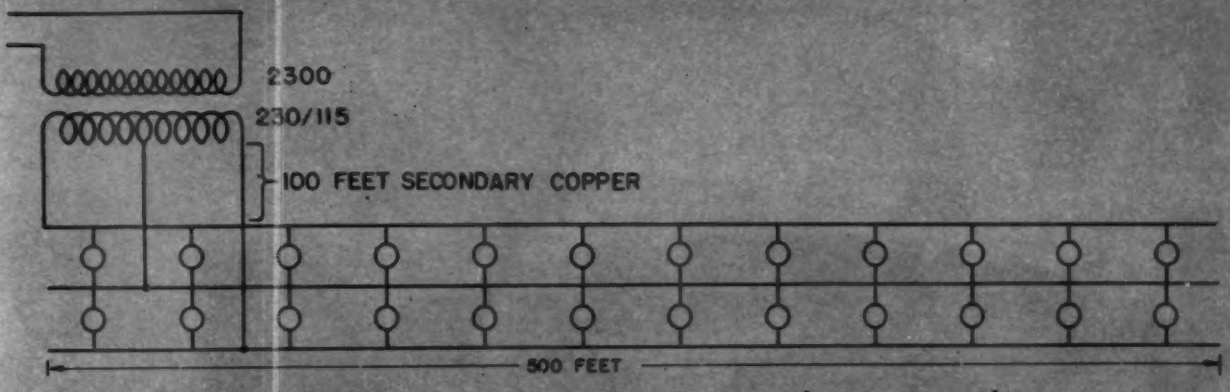
The sketches at the right graphically depict the simple solution. Investigate this method before you relight your next bay, floor, or building—and before making *new* installations—and specify G-E Pyranol transformers for use in your plant. Ask your G-E representative for complete details, or write for Publication GEA-3180. Address General Electric Company, Dept. 6 -201, Schenectady, New York.

If you want the ultimate in precise voltage control for your lighting, use one of these new G-E air-cooled voltage regulators on the secondary of each transformer. The total cost will still be less than with the old method. Ask for Bulletin GEA-3057.

Install your new lights. Use your old secondary wiring. Install small Pyranol transformers right at the load—near the ceiling—out of the way.



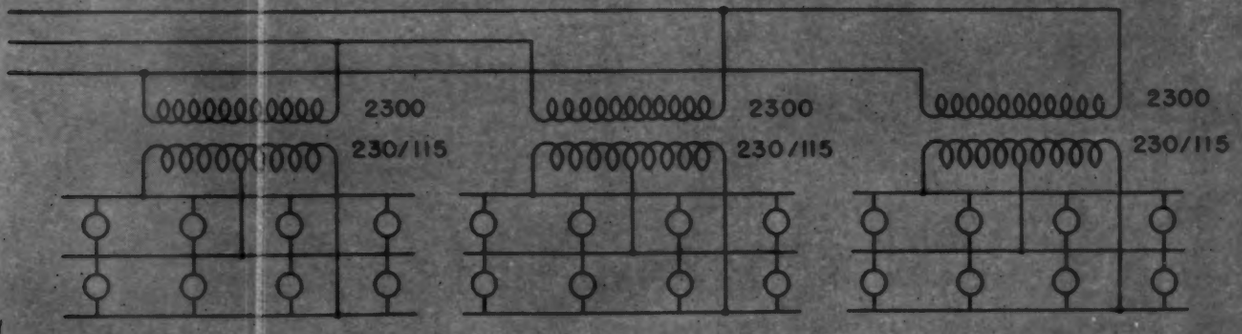
HERE WAS THE OLD METHOD — ASSUME COST AS 100%



New transformer in substation outside building—complete new secondary copper.

HERE'S THE NEW, LOW-COST METHOD — 60% COST OF OLD METHOD

(One of the three newer sources is shown in the picture at the top of this page)



NOTE

Install new primary feeder (small copper). Use existing secondary wiring, dividing it into several circuits. Install one Pyranol transformer in center of each circuit.

GENERAL ELECTRIC

300-80

70 WORDS THAT WILL ASSURE YOU A PERFECT, LONG LIVED WIRING JOB

CRESCENT OFFERS

the following choices of insulation for standard building wires and cables:

Code Grade
30% Performance Grade
ENDURITE Heat Resisting Grade
IMPERVEX Moisture Resisting Grade
Intermediate Grade

SOME CRESCENT PRODUCTS

Armored Cable
Bare Copper Wire and Cable
Control Cables, Braided and Leaded
Flameproof Wire and Cable
Flexible Cables
Flexible Steel Conduit
Lead-Covered Wire and Cable
Non Metallic Sheathed Cable
Parkway Cables
Power Cable
Rubber Insulated Wire and Cable
Signal Cables
Varnished Cambric Cables
Weatherproof Wire and Cable

We also manufacture wire and cable to meet *all* government specifications.

"Electrical wiring shall meet all conditions and requirements of the National Electrical Code and shall be of sufficient size to assure a voltage drop not greater than three per cent to the final distribution point. Insulation shall be one of the types listed at left, except where excessive heat will be encountered in which cases specify CRESCENT ENDURITE Heat Resisting rubber covered insulation. All wires and cables shall be Crescent."

Use this phrase as a standard for all your wiring jobs . . .

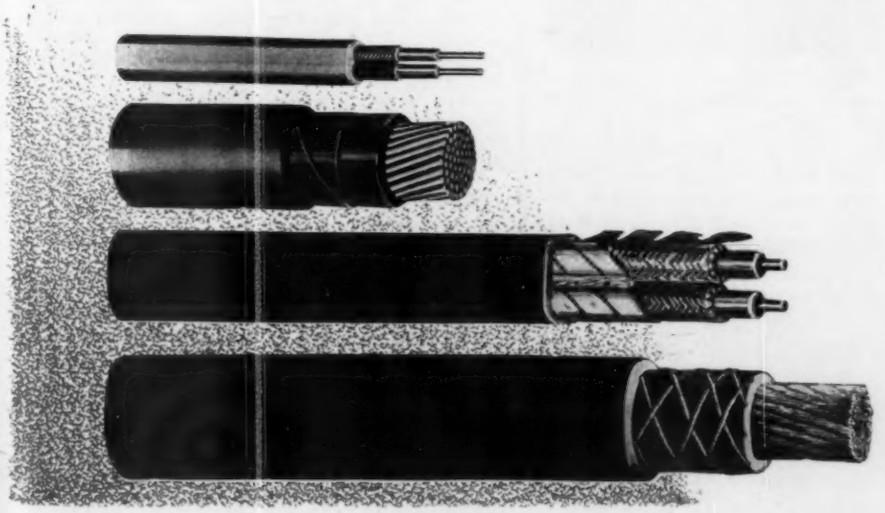
CRES

CENT

backed by over 50 years of

manufacturing electrical wires and cables that also assure you the best in electrical conductors . . . . .

CRESCENT
INSULATED WIRE & CABLE CO. INC.
TRENTON, NEW JERSEY



SALES REPRESENTATIVES

ATLANTA, GA., Edgar E. Dawes, A-4 Rhodes Bldg. Annex.
BALTIMORE, MD., Electrical Sales Co., 111 Cheapside.
BOSTON, MASS., C. C. Pierce Co., 241 Purchase St.
*BUFFALO, N. Y., Crescent Sales Co., 294 Elm St.
CHICAGO, ILL., Crescent Electric Sales Co., 624 W. Adams St.
*CINCINNATI, OHIO, The Henger-Fairfield Co., 124 E. 7th St.
CLEVELAND, OHIO, The Henger-Fairfield Co., 1808 Columbus Road.
DETROIT, MICH., Hemphill & Co., 517 E. Woodbridge St.
INDIANAPOLIS, IND., A. Lee Clifford, 330 W. New York St.
*KANSAS CITY, MO., W. F. Howe & Co., 2627 McGee St.
LOS ANGELES, CAL., Henger-Seltzer Co., 130 S. Hewitt St.
MINNEAPOLIS, MINN., R. H. Cupples Co., 324 First St., N.
*NEW ORLEANS, LA., Paul Hogan, Jr., 823 Perdido St.
NEW YORK, N. Y., Kearton & Nagle, 555 W. 25th St.
*PHILADELPHIA, PA., E. R. Blyler, The Bourse Bldg.
PITTSBURGH, PA., Crescent Sales Co., 298 Duquesne Way.
ST. LOUIS, MO., Leigh A. Doxsee Co., 815 S. 11th St.
SAN FRANCISCO, CAL., Hodges & Glomb, 1264 Folsom St.
*Do not carry warehouse stock.

TIME-PROVEN RELIABILITY

Luminous Tube Transformers

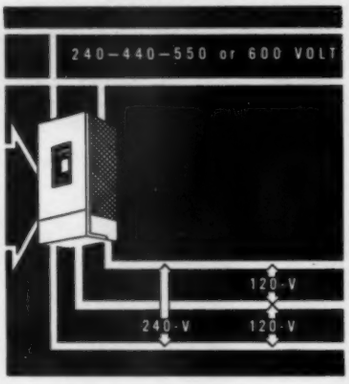
For Signs and Spectaculars

All Jefferson Transformers (above 5000 volt secondary) for luminous tube signs incorporate the midpoint grounded, balanced design principle—pioneered by Jefferson and largely responsible for the present efficiency and popularity of luminous tube signs. Made in types for every need, for indoor and outdoor service—all designed especially for their purpose.

For Interior Illumination and Decoration Systems

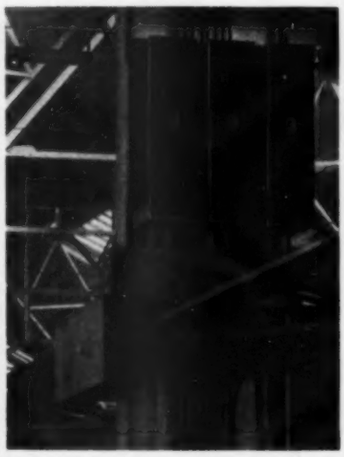
To improve the present use of the highly efficient fluorescent luminous tubing for interior illumination and decoration, Jefferson has added the Series 727 Transformers particularly suited for this service. These Transformers may be mounted recessed in wall, ceiling or post, or installed on the surface. High tension cables are eliminated, electrode housings are recessed and connections to the primary are quickly made by means of convenient screw terminals. There are knockouts for conduit entrance and adjustable brackets for either surface or recessed mounting. When recessed, flush plates are available.

Power Circuit Transformers



Instead of distributing both low voltage (110-120) circuits and high voltage power circuits with their duplication of conduits and wiring—present practice in industrial plants is to distribute only the higher voltage current. This saves installation expense, cuts line losses—and cuts electric bills by reason of lower Kwh rate.

For lighting, fans, small electric tools and appliances, Jefferson



Three of 31 Jefferson Air-Cooled Power Circuit Transformers in metal-working plant.

Air-Cooled Power Circuit Transformers are installed wherever required. Being air-cooled, they present no fire hazard—and may be mounted on wall, post, or floor.

Jefferson-Union Renewable Fuses

For over 40 years Union Fuses have established their worth—simple, rugged, easily renewable, Jefferson-Union Renewable Fuses should be in your stock in all standard capacities.

Jefferson Fustats

A combination fuse with thermal cutout—resists tampering and stops over-fusing. Thermal cutout provides a long time lag and prevents blowing needlessly on harmless motor starting loads. Stops over-fusing because 20 or 30-ampere Fustats will not fit into a 15-ampere adapter. Similar limitations apply to all sizes. Available up to 30 amperes.

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JEFFERSON ELECTRIC PRODUCTS

electrical contracting

With which is consolidated The Electragist and Electrical Record
Established 1901

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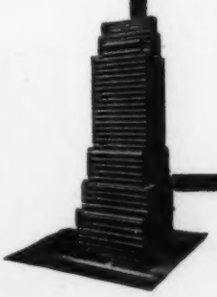

A SERVICE PAPER for electrical contractors, engineers, motor shops, industrial electricians and inspectors, covering engineering, installation, repairing, maintenance and management, in the field of electrical construction—industrial, commercial, and residential.

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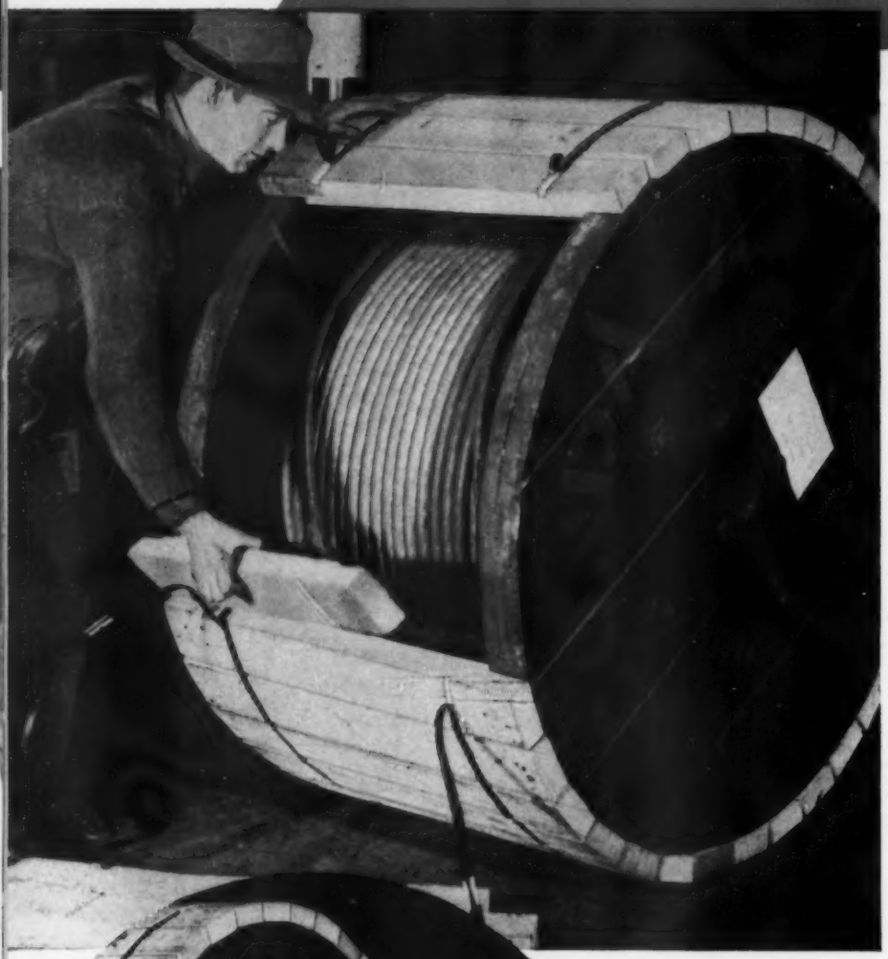
To protect your profit

We use offset lagging... easy to remove... ends nail nuisance



This shows how easy it is to open a reel of Anaconda cable protected by offset lagging.

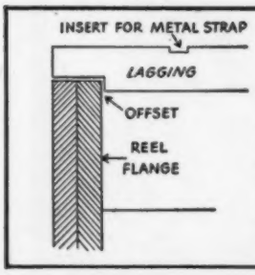
Label on end of reel gives place to make a record of lengths removed thus furnishing you with exact number of feet remaining.

WE KNOW you value the modern, improved insulations offered by Anaconda. That's why we devise special, improved "packages" to bring them to you. This offset lagging on the Anaconda cable reel is an example.

See how simple and easy it makes everything. First of all, there are no nails to weaken the flanges of the reel. Second, instead of the troublesome old way of removing individual nails, you remove this lagging without the least trouble.

There's no danger of stepping on nails... furthermore, no danger of nails damaging insulation. The label pasted on the reel has space to write down the number of feet of cable removed; thus it gives you a ready reference record that tells just how much is left on the reel. A small matter, maybe, but mighty convenient.

In these and other ways, we work to protect your profit on Anaconda products. Anaconda quality makes this line the easiest to sell. The line is complete. There's an Anaconda product for every wiring requirement... each manufactured for greater service, greater sales, greater profit for the wholesaler and contractor. Why not concentrate on the Anaconda line? 39815



This diagram shows what an improvement Anaconda offset lagging is. Steel straps hold the lagging in place and do away with need of nailing. Easier to remove... protects insulation and you from nails.

FOLLOW THE SPEARHEAD TO AN ANACONDA DISTRIBUTOR

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from mine to consumer
WIRE & CABLE

USE MODERN IMPROVED *Anaconda Wire & Cable*

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A subsidiary of Anaconda Copper Mining Company • Sales offices in principal cities

electrical contracting

APRIL, 1939

High Priced Smoke

ABOUT THE SNOOTIEST SMOKE a man can smell comes from the *Corona Corona* and the *Bock Panetela*. They have long been the most famous of Havana made cigars. So the world was shocked one day when they moved the whole works up to Trenton.

THE REASON? Why the Cubans, who had been rolling these perfectos and panetelas, each consumed ten cigars a day himself. It totaled 4,500,000 a year. And all the profits were burned up in entertaining the help. But New Jersey girls prefer cigarettes.

I MAY BE WRONG. There are a lot of things I don't understand. But to me, it looks like it is about time for the electrical contractor to close his Havana shop, too, and get up on the Delaware and make some money.

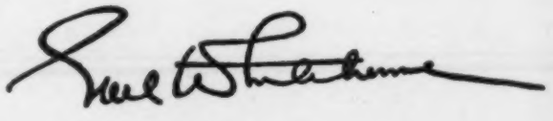
THE CORONA PEOPLE PULLED OUT of Havana because they thought it would be a smart idea to sell these 4,500,000 high priced cigars and quit giving them away. I am thinking it would be no less smart for contractors to quit giving so much of their work away.

THE CURSE OF THIS BUSINESS is that the buyer seldom knows the difference between quality and tripe. You tell your customer—"This is the thing!" He believes you. Then comes another bidder and says —"But this is cheaper and good enough!"—And the poor prune falls for it.

IT IS OUR FAULT, OF COURSE. I say it humbly. But we fail to sell this customer precisely and securely on the quality and quantity we offer him. We fail to give him both conviction and proof that that is what he wants. And so the chiseler cuts him down.

MOST PEOPLE DESIRE TO BUY WELL. Let's build on that. Let's write better specifications. Let's sell specific quality material and prove skill on all big jobs. And on smaller work, let's give no bid that is not covered by a drawing and a schedule which makes plain just what we offer and its value. This is good selling.

IT IS MORE THAN JUST PRICE COURAGE. It is the common sense policy of doing less bidding and making more money on it—of selling your cigars and not smoking them in the factory. And any contractor can move to Trenton, if he wants to.



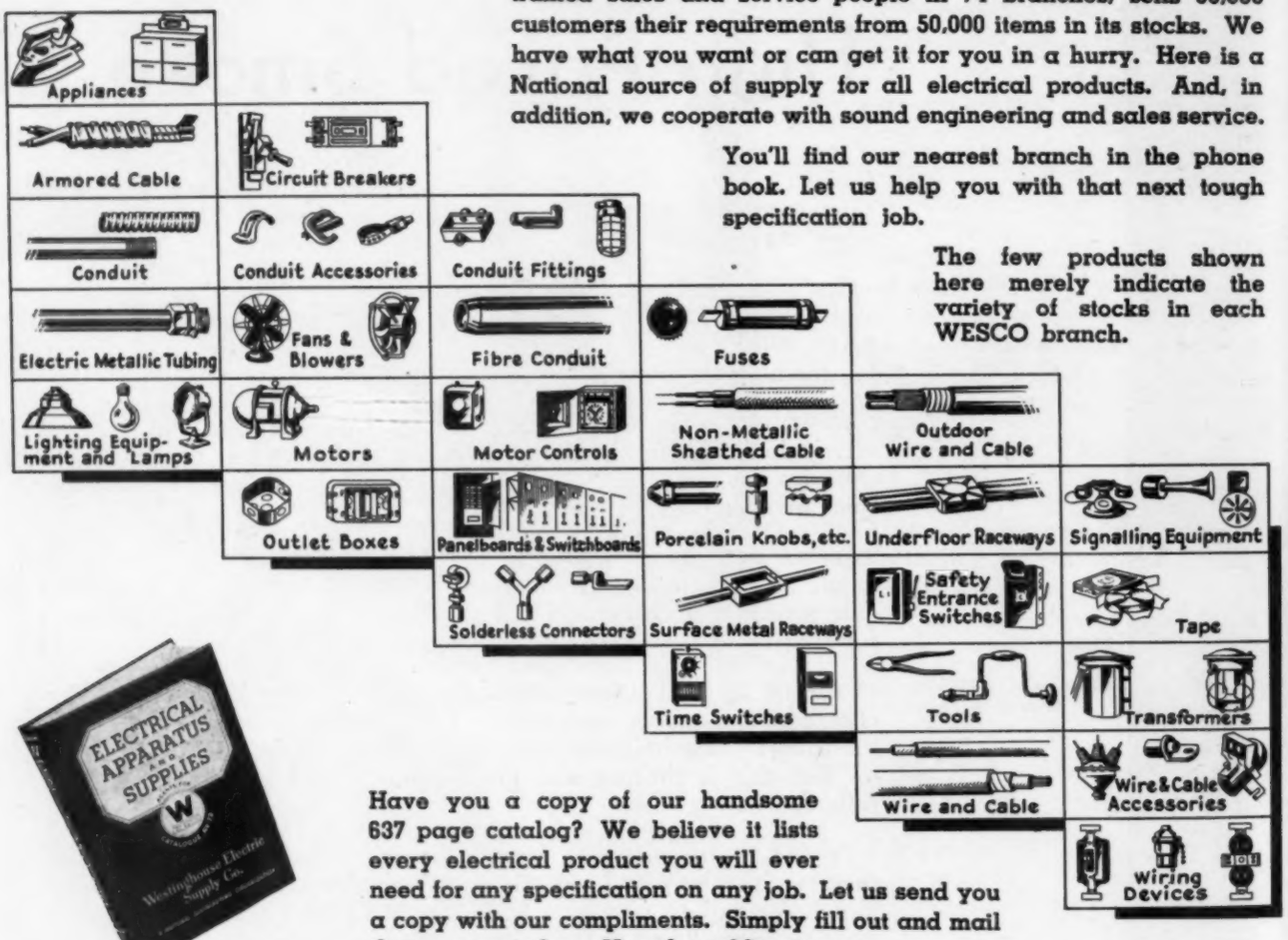
Specify *WHAT* you want . . *WHERE* you want it . . *WHEN* you want it . .

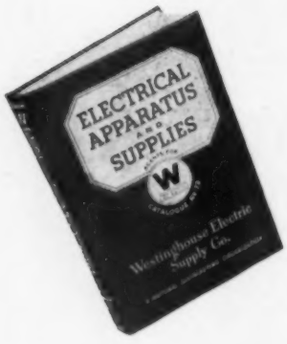
We Have It!

Westinghouse Electric Supply Company, staffed with 2200 trained sales and service people in 74 branches, sells 60,000 customers their requirements from 50,000 items in its stocks. We have what you want or can get it for you in a hurry. Here is a National source of supply for all electrical products. And, in addition, we cooperate with sound engineering and sales service.

You'll find our nearest branch in the phone book. Let us help you with that next tough specification job.

The few products shown here merely indicate the variety of stocks in each WESCO branch.





Have you a copy of our handsome 637 page catalog? We believe it lists every electrical product you will ever need for any specification on any job. Let us send you a copy with our compliments. Simply fill out and mail the coupon today. No other obligation.

Westinghouse Electric Supply Company
150 Varick Street, New York City

☐ Please send me copy of your Catalog No. 72.

☐ Only in case I check this space—have a representative call to discuss electrical specifications.

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City .....State.....

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Electric Supply Company

150 Varick Street **New York City**

A National Distributing Organization

BRANCHES IN 74 CITIES

BUILDING a Balanced Volume

When a business grows large in its field, there is usually some good reason. Here is why the Central Armature Works, Inc., clicks in Washington, D. C.

THREE KINDS OF BUSINESS *make this substantial building hum with steady volume.*

AT THE CONTROL, *to smooth out rough going are Henry J. Doerr (left), president; E. A. Camp, sales and purchases; Walter Bailey, in charge of shop; below, the personnel that rolls the load.*

OFF-HAND one would not expect to find a large motor service shop at the nation's capitol. For Washington is not an industrial city. And without much in the way of industrial activity going on, a complete shop like that of the Central Armature Works, Inc., stands out conspicuously.

This company's three-story and basement fireproof building is located several brassie shots from Pennsylvania Avenue, and only a short stroll from some of the capitol's newest structures. And from top to bottom, its 22,000 square feet of concrete floor area is jammed with activity.

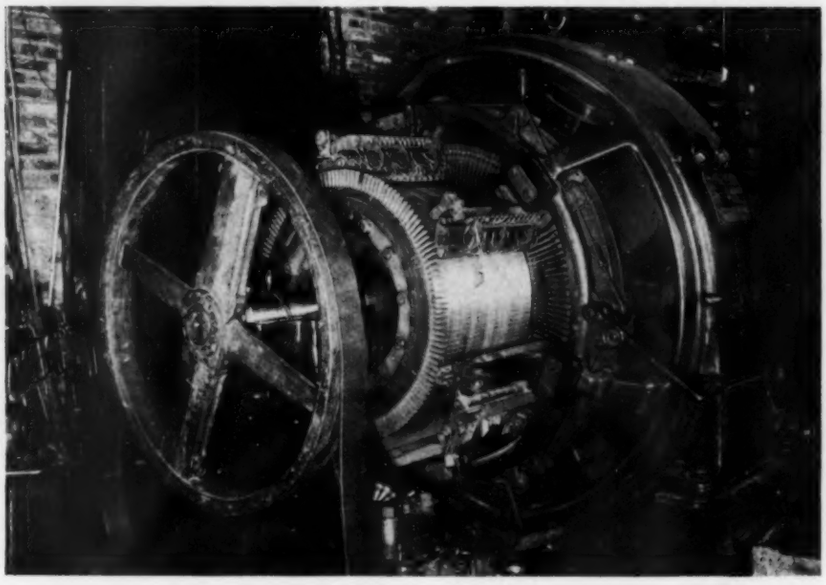
For new motor sales here bulk $40,000 to $50,000 per year. The average inventory is $30,000 in staple supplies. And a staff embraces 40 employees in the shop and in construction work. The sale of V-belts and sheaves, over the counter and for use in modernizing customer equipment, runs $4,800 per year. And all this despite stiff competition from nearby Baltimore.

Here are some of the activities that keep Central Armature Works busy—

1. Complete motor service shop for reconditioning all sizes of motors, generators and control apparatus.
2. Special mechanics in a separate department to handle electric tool service and small motors.
3. Transformer department for reconditioning large power company equipment.
4. Complete equipment for heavy machine work, spraying metal on worn shafts, and welding.
5. Construction department, specializing in power wiring and plant changeover work.
6. Outside service crews trained to shoot trouble wherever found on complicated control equipment.

TRANSFORMER SERVICE *requires special facilities, so a separate department runs it. And this* 11-*ton,* 1100-*kva,* 6600 *volt unit is being handled with care.*

FLOOD DAMAGE—*Testing the reconditioned armatures from* 80-*hp.* 5500-*volt motors of the Memorial Bridge before re-installation.*



HEAVY APPARATUS—*This 65-ton converter from a government building required reconditioning, while installation crews handled rewiring and installation details at a new location.*

7. Apparatus sales staff trained in applications of motors, drives and control.
8. Stocks of new and used motors, parts, accessories and supplies.

Most of this business comes from communities within 30 miles of Washington. It is drawn from government buildings and several power companies, as well as electric elevator service companies, local electrical contractors and individual customers.

It all sums up as a good example of the value of building a well balanced organization and operation. For this company maintains an efficient relation between machinery repairs, apparatus sales, supplies and installation work. This sounds simple enough on paper, but to make it succeed in a non-industrial city requires management. This is the job of Henry J. Doerr, who as president of the company, heads up the staff of 40 workers. Assisting him are Walter Bailey, in charge of the shop, and E. A. Camp, in charge of apparatus and supply sales. This three-man teamwork keeps six trucks rolling on service calls, bringing in business, and delivering apparatus and supplies sold in the Washington area.

Since this company was established in 1915, it has taken on various work usually considered a little out of the ordinary for the motor shop. For example, facilities for repairs were developed to handle large transformer work as well as the full range of motors and generators. A $30,000 layout for the machine shop brings in important jobs to re-build special equipment, or to apply motors to machines. And then small motors and tools have been centered in a special division that renders quick service.

The construction and sales departments are geared to the shop. Installation and changeover crews draw upon its resources for smoothing out tough spots. And in selling new apparatus, controls, drives or supplies, both the shop and construction departments get new leads for business as well as co-

operate in working out practical application problems. It makes a perfect combination, because these departments coordinate under some simple rules that guide their procedure.

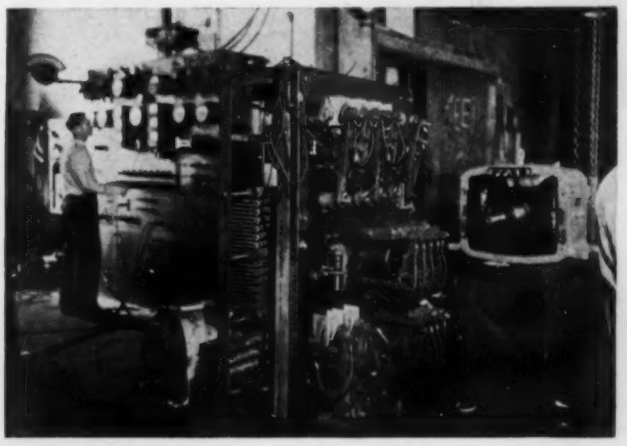
1. Each department is operated so as to avoid upsetting good will for another department.
2. Since the shop serves electrical contractors, the contracting department avoids unfair tactics in outside bidding.
3. Sales of apparatus and supplies are made as specialists, and not in competition with wholesalers, and not to disturb other contractor's customer relationships.
4. Trouble shooting is in charge of four service men who know special motor and control apparatus. They are called out on new installations made by contractors and on equipment in government buildings, which is under guarantee. Tactful procedure by this crew makes friends, especially with machinery manufacturers.
5. Elevator apparatus repairs are not made directly for building owners, but are limited to elevator service organizations. This broadens the scope of shop work, without encroaching upon the specialized field service of these organizations.
6. Machine shop work is not solicited, but is limited to what may be required in connection with electrical apparatus, changeovers and the fabrication or development of special test machinery for government bureaus.
7. Regional service is handled for electrical manufacturers, such as motors, heavy control, motorized tools. It is handled with strict impartiality and in a manner that avoids conflict in the apparatus sales department.

Here then is a closely knit service organization that passes up nothing from the smallest motor or electric tool to a large power transformer. A cross-section of the customer list includes:

Power companies
Government bureaus
Breweries
Sand and gravel plants
Brick yards
Bottling works
Railroads
Elevator service companies
Motor manufacturers
Planing mills
Ice cream plants
Controller manufacturers
Stores and hotels
Office buildings

Capitalizing this diversity of electrical service has required coordination of shop, sales and field service. At the Central Armature Works it all clicks. Which proves that a balanced industrial service, properly managed to meet the local demand, can be expanded.

CUSTOMER CONVENIENCE *prompted this up-front service station for small tools and motors. It saves delays and trips back and forth to the main shop areas.*



SPECIAL SERVICE *for contractors and elevator companies. Here a controller and its motor get general reconditioning before re-installation in another building.*

POWER TRANSMISSION *headquarters, where the volume in v-belts and pulleys has grown to* $400 *per month.*

MACHINE SHOP *functions justify a* $30,000 *layout of modern equipment that keeps the whole job in the shop.*

CUSTOMERS NEED *industrial supplies and these two salesmen up front deliver materials and equipment over the counter.*

COMFORT for Summer Camps

Use these ideas to sell wiring comfort for summer cabins on your nearby lakes

REST HEADQUARTERS—*Thousands of summer camps in all our vacation spots can enjoy extra comfort the electric way.*

CORDS MINUS—*Planning for comfort and entertainment adds permanent facilities that won't let hosts down at critical moments.*

ALMOST every family, while the children are growing, yearns for a cabin in the great outdoors. But the modern family also likes plenty of the everyday city comforts. Which means that cabins on the lake shore today should be well wired for all the electrical equipment that will add to vacation enjoyment.

Proof of this is found in the experience of an alert New Hampshire electrical contractor, who does lots of work for big-city people who build lake-shore cabins in the Granite State. For when Chellis Sanborn, of Laconia, approaches a cabin-building prospect, it is not "just another cabin job." The wiring layout for a recent Lake Winnepesaukee installation shows comfort provisions that exceed those in many town homes.

These features are there because some definite ideas are sold to these prospective cabin builders. In a word, Mr. Sanborn impresses them with these important facts—

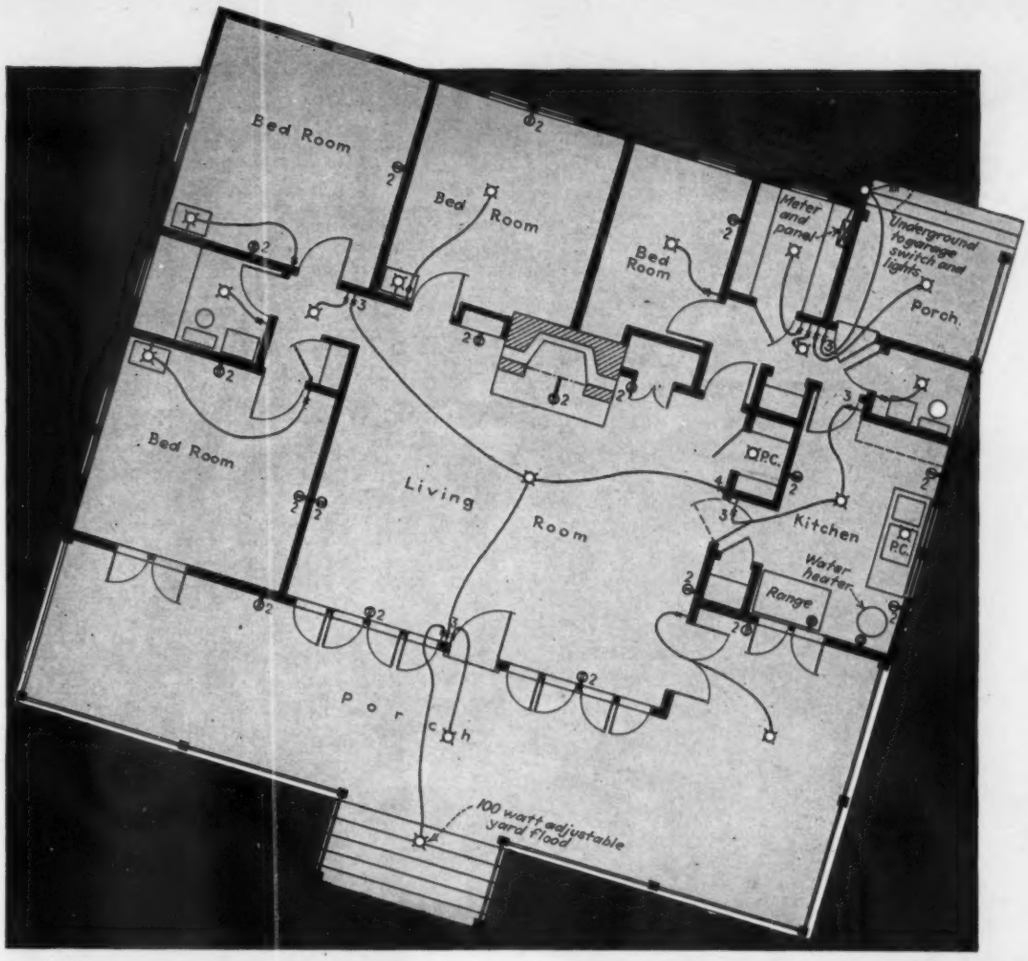
1. Vacationing families usually spend a large part of the summer on the lake shore. So all the comfort facilities of the city are needed.
2. These people come and go in a hurry. They need to get organized and to get away on short notice. So the wiring system should be always ready for service without annoyance from breakdowns or delays.
3. Cabins are often crowded with guests, sometimes "loaned out" to them. These people are strange to their surroundings, therefore handyman wiring arrangements, flimsy outlets or awkward control facilities are embarrassing and dangerous.
4. Summer recreation extends to night time, when good lighting and handy switching are needed to prevent injuries to young and old children playing around yards, walks, docks, woodpile or garage.
5. Heavy-duty wiring is called for, because out-of-the-way camps depend upon electrical cooking, water heating and pumping.

Working on this basis, Sanborn makes adequate layouts. They offer pointers that should help other contractors sell comfort wiring for lake-front cabins—

1. Heavy-duty wiring for kitchen appliance outlets.
2. Three-location control of living room fixtures.
3. Adjustable floodlights to light up front yard and boat dock, also for backyard and pathway to garage.
4. Convenient plug-ins for all rooms, especially in the living room and large screened-in porch.
5. Lights over washbowl-mirror locations in all guest rooms.
6. Lights in all closets.
7. Separate heavy-duty circuits for range, water heater and water pump.
8. Main service of three No. 4 conductors.

Here, then, is an example of adequate cabin wiring for others to shoot at. It proves that cabin owners want wiring comfort without the hazard of cord makeshifts. The big job is to approach prospective owners with comfort ideas. They are wanted.

So apply Mr. Sanborn's Five Points of Comfort for Summer Camps in your lake areas. Get in one good job as an example. It will set a new standard for your selling. Results will follow.

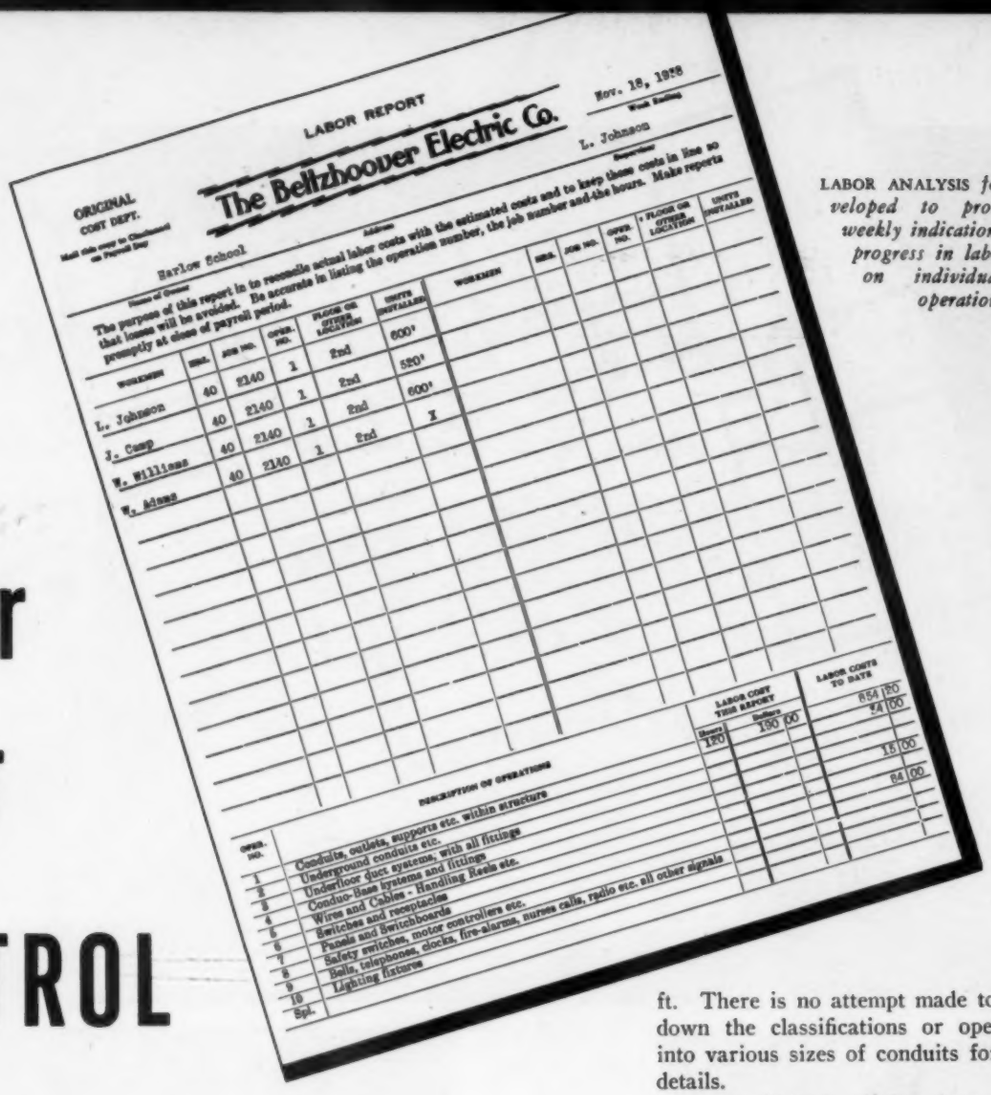


SELLING THE PLAN *requires only the observance of obvious needs for vacationing families. The layout records the final arrangement.*

MODERN SERVANTS *belong in the cabin kitchen so all can enjoy vacation pleasures. Quick meals are assured by adequate wiring.*

AFTER DARK SAFETY *requires lighting for paths to beach or dock where tender feet and shins often take cruel punishment.*

STUMBLE INSURANCE *for night trips to garage, woodpile and points beyond, comes from providing a few practical lighting remedies.*



LABOR REPORT

The Beltzhoover Electric Co.

Nov. 18, 1938

L. Johnson

ORIGINAL COST DEPT.

Harlow School

The purpose of this report is to reconcile actual labor costs with the estimated costs and to keep these costs in line so that losses will be avoided. Be accurate in listing the operation number, the job number and the hours. Make reports promptly at close of payroll period.

WORKMEN	HRS.	JOB NO.	OPER. NO.	FLOOR OR OTHER LOCATION	UNITS INSTALLED
L. Johnson	40	2140	1	2nd	600'
J. Camp	40	2140	1	2nd	580'
W. William	40	2140	1	2nd	600'
W. Moss	40	2140	1	2nd	3

OPER. NO.	DESCRIPTION OF OPERATIONS	LABOR COST THIS REPORT Hours	LABOR COST THIS REPORT Dollars	LABOR COSTS TO DATE
1	Conduits, outlets, supports etc. within structure	120	150 00	854 80
2	Underground conduits etc.			54 00
3	Underfloor duct systems, with all fittings			
4	Combo-Base systems and fittings			15 00
5	Wires and Cables - Handling Reels etc.			
6	Switches and receptacles			64 00
7	Panels and Switchboards			
8	Safety switches, motor controllers etc.			
9	Bells, telephones, clocks, fire-alarms, nurses calls, radio etc. all other signals			
10	Lighting fixtures			
Spl.				

LABOR ANALYSIS *form developed to provide a weekly indication of the progress in labor costs on individual job operations.*

Labor COST CONTROL

Based on a simple method of weekly reports used by the Beltzhoover Electric Company of Cincinnati.

THE largest variable in the electrical construction contract is labor costs. Material costs may vary widely, of course, but by proper inventory control and job quotations on the large or special items, these costs may be controlled within narrow limits by the office staff. The same is true of miscellaneous job expenses. So with a reasonable degree of vigilance on the part of the estimator and the superintendent, the miscellaneous costs can be anticipated and held within narrow limits.

The methods of electrical contractors in analyzing labor costs differ widely. The problem is to provide an accurate analysis at brief intervals in a form that will quickly indicate variations from estimated figures, so that losses can be avoided.

The Beltzhoover Electric Company of Cincinnati, Ohio has prepared a report form for transmitting payrolls from the job to the office which includes a weekly labor cost analysis. The report is made out in triplicate. The original is filed in the cost department, a copy bound in a labor report book in the superintendent's office and the third retained in the job record.

The payroll form lists the names of the workmen, the hours worked and the job number. Three additional columns give the essential labor control information. At the bottom of the page the various operations of the jobs are listed and numbered in ten classifications with room for an additional special classification. Opposite the workman's name is entered the operation number of the type of work he was doing, the location of the work and an approximate estimate of the number of units installed. In the case of operation No. 1, i.e., conduits, outlets, supports and so forth within structure, the tabulation would read, operation No. 1, first floor, 250 ft. There is no attempt made to break down the classifications or operations into various sizes of conduits for other details.

At the bottom of the sheet, where the operations are listed, two columns indicate the job progress. Under each classification in a column headed "Labor Costs—This Report" the number of hours and the dollar cost applying to that operation is entered weekly. In the second column the labor costs to date are accumulated.

In the supervisor's report book in which the labor reports are filed by jobs, a break down of the estimated labor on each job is tabulated according to operation numbers to coincide with the weekly labor report. As the labor reports are filed in such a way that the latest form always faces the estimated operations cost, the status of the job and the cumulative labor costs on each operation may be compared with the estimated figures at a glance.

The labor analysis report is a part of the regular payroll form and the only additional paper work required of the job foreman is the classification of each workman's output into one of the ten operations listed. After that the analysis of the job progress and labor cost analysis is a simple clerical job in the office.

Electrical Specifications

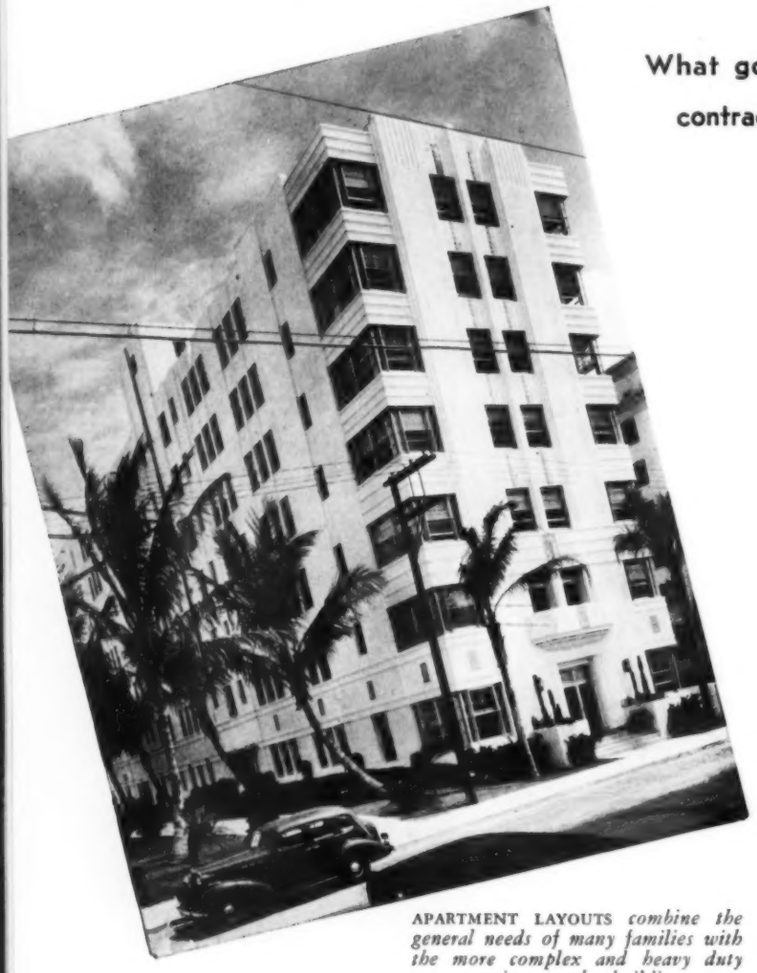
Good specifications produce good wiring jobs and protect profits. Poor specifications make trouble for owners and their architects and lose money for the contractor. It pays to do it well!

This review of design and specification procedure is presented, therefore, to check against your present methods. It embraces wiring for light, power and signalling — modern standards, engineering data, diagrams.

It discusses the use of specifications in selling. It sets down guiding rules for planning and specifying wiring systems for residences, apartment houses and farms, for commercial, institutional and industrial buildings.

Taking the GAMBLE

What good plans and specifications are worth to the contractor—How he can use them to his greater profit.



APARTMENT LAYOUTS *combine the general needs of many families with the more complex and heavy duty services to the building.*

FIVE people have their fingers in the wiring of a new building. Each one of them should understand clearly just what this wiring installation is to embrace—and why—just how it is to be put in—and when—and what it will cost. These five interested people are—

1. *The owner*

He wants to be sure that complete electrical facilities are provided which give him the most for his money. These facilities he measures in terms of safety, convenience, permanency, adequacy, efficiency and avoidance of future trouble.

2. *The architect or consulting engineer*

He wants to be sure that his client is protected against deviation from intended standards of quality, completeness and workmanship and against claims for extras. He must see that plans and specifications clearly and fully provide for the needs of his client.

3. *The builder or general contractor*

He wants to be sure that his budget includes an estimate for wiring, which fulfills his obligation to give the owner and architect a complete electrical installation.

4. *The electrical inspector*

He wants to be sure that proper provisions are made for safety, adequacy and convenience, and to avoid the delays and extra expense that reinspections cause the owner.

5. *The electrical contractor who does the job*

He wants to be sure, when bidding on plans and specifications, that he is protected against unreasonable demands due to vague or incomplete plans or specifications, and that in submitting a proposal to do a good job, he is not at the mercy of unfair competition.

Now since all these men look at the job from different viewpoints, it is not difficult for misunderstandings to creep in. In fact, there is only one way to avoid it. And that is to put the whole purpose and program on paper in a set of plans and specifications that cover every detail clearly. For if nothing is open to doubt or misinterpretation, then everybody gets the same picture of the job. But if descriptions are indefinite and incomplete, anybody reading from the angle of his honest self interest may get a wrong idea as to what is planned or promised. He may do the wrong thing. Conflicts easily result—and losses.

The common defects in careless and incomplete plans and specifications come from—

RESIDENCE WIRING *can follow established standards that provide general adequacy requirements for all parts of the home. But with these standards there is opportunity for extra comfort and quality that is worth selling.*

OUT of WIRING

1. Insufficient outlets indicated.
2. Improper location, spacing and arrangement of outlets.
3. Vague symbols lost in cluttered plans.
4. No layout covering outlet grouping or routing of important runs.
5. Lack of details covering special construction or assemblies.
6. Capacity of service, feeders and equipment not stated.
7. No clear provisions as to spares, future loads and leeway beyond the Code minimum.
8. Grades of material not clearly stated.
9. Scope of work indefinite.
10. No coordination of layout with other building conditions.
11. No allowance for voltage drop.

It is essential, therefore, that the planning and specifying of a job be based upon the firm foundation of well organized facts. The program must be built up in an orderly progression, step by step, that embraces—

1. Determining the various outlets needed and their load requirements.
2. Locating these outlets on a plan or layout.
3. Designating all outlets upon the plan by the correct symbols.
4. Calculating and designing the circuit and feeder system.
5. Preparing detail drawings to cover special equipment or installation conditions.
6. Writing definite specifications to incorporate correct materials for all requirements.

To set up the job in this logical sequence with complete assurance of accuracy, the person who lays out an electrical system must be competent and accurate. He must know the prevailing laws and codes and standards for that type of job in that locality, including—

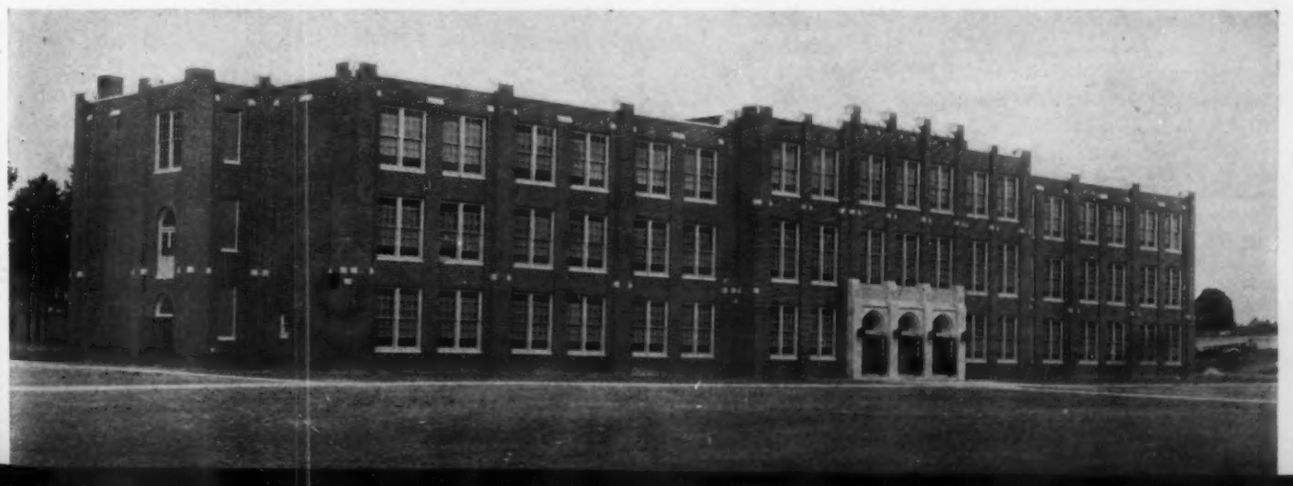
1. National Electrical Code.
2. Local and state laws.
3. National Adequate Wiring Standards (Handbook)
4. Standard loads for illumination.
5. Wiring recommendations of manufacturers covering their equipment.

Primarily, therefore, plans and specifications are a measure of the quantity and quality of an electrical installation. The plan provides a tangible exhibit of the structure or premises, upon which are indicated clearly whatever electrical facilities have been decided upon for the various floors. Specifications state definitely the scope of work to be performed and the grades and makes of all materials to be installed. This done, the electrical contractor who submits his bid, the architect or builder who checks the bid, and the owner who is to pay for and use the wiring, are all informed. No advantage can be taken by one party over another. Unscrupulous bidders are restrained from attempting to skimp the job. Confusion is avoided. Unnecessary delay is eliminated. Investments and profits are protected.

The Approach to System Design

In the preparation of wiring plans and specifications, the procedure naturally differs for different classes of buildings. For this reason the following chapters give

INSTITUTIONAL LAYOUTS, *as for schools, usually suffer from competitive bidding. Since these jobs are seldom better than the plan and specification requires, initial designs should set a standard ample for meeting electrical needs for many years ahead.*



separate suggestions for residences, apartments, farms, commercial, industrial and public buildings.

The purpose is to set down in proper order the considerations that should govern system design and the elements that should make up the specification, for different classes of work. No attempt has been made to present the exact words to be written into any specification, because each job calls for its own description. It is more practical and helpful, therefore, to use a guiding schedule of features and factors that a complete specification should include. Then whatever the job requires may be written in by a simple statement, with assurance that nothing has been forgotten. In selecting and describing materials for any installation, however, it is well to have the following points in mind—

A. For Residences

Plans for the home should follow the general rules of adequacy in outlets and control that have been established as standards for every room. There remains but the matter of including extra features to suit unusual room arrangements or owner preferences. So the laying out of an average residence system is a generalized procedure. But the specification must clearly set forth the grade of materials, provisions for additional capacity, and all features of special circuiting and feeder design that are not made clear on the plan.

B. For Apartments

Although an apartment building is essentially a multiplication of dwelling units, the wiring design requires more detailed treatment both in the plans and specifications. After the room requirements for adequacy of outlets and control have been determined, there remain—

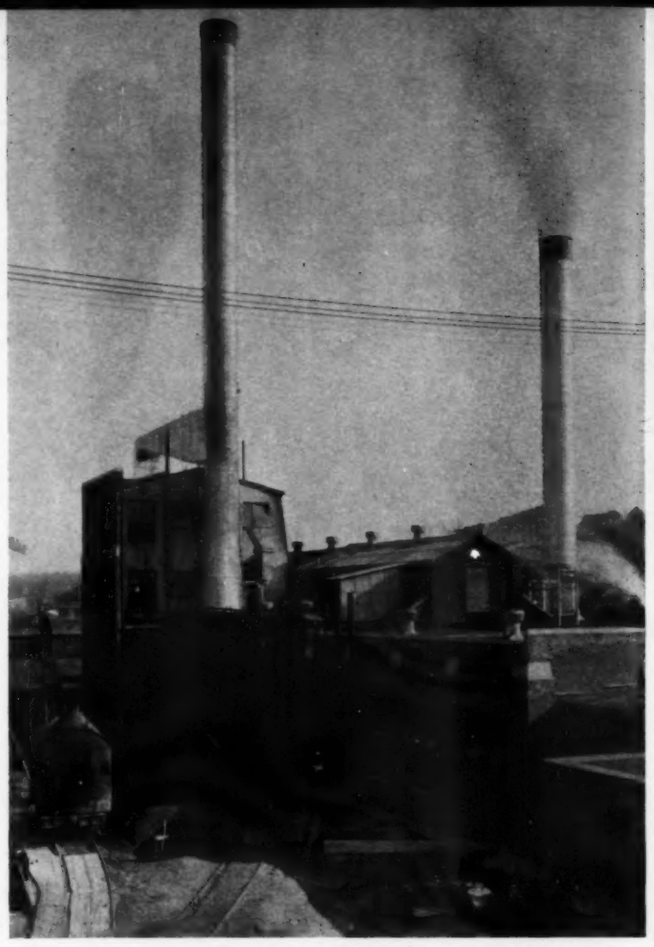
1. The lighting of halls, public areas and store spaces.
2. Special power and signaling requirements.
3. Metering and feeder facilities.
4. Coordination of wiring plans with other mechanical work.

The wiring plan must clearly tie the dwelling units together in a balanced system. The specifications must establish the types and grades of materials that are to be used.

C. For Farms

Plans are seldom available for farm buildings and the wiring is generally covered by a layout sketch and a schedule of outlets. But since farms combine house wiring with other small buildings using light and power, the contractor should prepare—

1. A layout sketch and schedule of outlets for the dwelling, based on regular residence standards of adequacy.
2. Separate sketches of larger farm buildings, showing outlets and controls, and a schedule of outlets for smaller buildings.
3. A sketch, showing the service pole and feeder layout to all buildings, indicating sizes of conductors employed and, a supplementary schedule of feeders and special outlets, where necessary.
4. A specification covering the full scope of work, defining grades of material and special provisions for future loads.



MODERN FACTORIES *need heavy duty service and materials that stand hard usage. Unrestricted electrical facilities should be provided. Bare necessity wiring systems soon restrict production.*

D. For Commercial, Industrial and Public Buildings

Electrical work here must provide for specific loads and functions that vary from one area to another, so the wiring requirements in these buildings can seldom be covered by any general rules. The plans can not be marked with outlet symbols until lighting layouts, power loads and signaling systems are determined. And the layout and specification procedure is influenced considerably by—

1. Structural conditions affecting system design and choice of wiring methods.
2. Character of load demands as to flexibility and future expansion.
3. Abuses or hazards prevailing in certain areas.
4. Selection of equipment, wiring system and type of electrical service.

E. For Re-wiring Old Buildings

Here plans are seldom available, so the contractor is usually required to describe the proposed work after a survey of the premises. System designs for rewiring should always be supported by a layout sketch that covers the principal work involved and a brief specification of such essential elements as feeder sizes, switch ratings, number of circuits and grades of material. More elaborate electrical plans and specifications may be justified in some instances. The purpose is to provide the customer with a clear explanation of his needs, how your layout will meet them and in what way your work ties in with or alters the existing system. Select materials, as in specifying new work for the different classes of buildings

F. What To Do For Small Jobs

Up to this point our discussion has dealt chiefly with procedure for designing or improving electrical systems that employ plans and specifications. Yet a great deal can be done to raise the standards of smaller work which is never covered by plans. For among the widely varying classes of small jobs on which electrical contractors quote, there are likewise differences in opinion as to the best methods and materials to use. The best protection against "cheapness" in competition from other bidders is to—

1. Make simplified layouts or sketches that show the work.
2. Prepare brief specifications that cover grades and sizes of material.
3. Submit concise proposals based on layout and specification.
4. Make a salesmanlike presentation of every proposal.

In a word, make sure your customer understands your layout, and has confidence in the standards of materials you propose to install. For residence work, use a "customers layout sheet," cutouts of furniture, that show whether outlet positions are convenient for different furniture arrangements, and replicas of convenience outlets, that can be thumb-tacked on the wall to show where new outlets are needed. These forms may be purchased at small cost from the National Adequate Wiring Bureau, 155 East 44th Street, New York. All this makes it easier to sell customers what they need and to insure that other bids will be obtained on the same number of outlets and standards of materials.

BUSINESS BUILDINGS *rapidly outgrow their electrical facilities, if the wiring fails to provide for the needs of changing tenants. But adequacy can be assured for years ahead when planning anticipates future demands throughout the building.*

G. Working With Architect and Engineer

The electrical contractor is key man in this group concerned with electrical layouts for different kinds of buildings. He is in a fortunate position to help the others and in so doing help himself. And in most cases the way to do it is to work closely with the architect through the planning stages of the job. And there are plenty of places to lend a hand, such as—

1. Advocate the use of correct electrical symbols.
2. Promote the use of quality and adequacy standards.
3. Assist in checking the owner's needs based on past experience with the type of building being planned.
4. Recommend specialists to help in working out complicated phases of the electrical job.
5. Supply essential data on conditions affected by local ordinances and power company regulations.
6. Explain riser layouts, special equipment groupings or control ideas that will improve the job.
7. See that such essential items as scope of work, grades of material, alternate bids, approval of final layouts and shop drawings are covered in the specification.

The contractor who points out the importance of careful designing in electrical systems, wins the confidence and approval of the architect and engineer. And their support opens many doors to more business.

Specifications Help You Sell

As a matter of fact, there is a selling side to plans and specifications that is overlooked by too many electrical contractors. Yet it has been proved mighty profitable by others who have made a practice of assisting in the writing of electrical specifications for architects and engineers. For the average architect is not as well informed on current details of electrical design and equipment as the contractor. The average engineer is not as familiar with new methods and materials. Why should they be? Therefore, they welcome the cooperation of the contractor.

So it pays to participate actively in the planning of jobs, that you expect to bid on and hope to secure. It means that you can write in the materials that you know are best for the job. You can guide the system design so that it offers economies in labor and supervision. You can make sure that everything is so well defined, that no other bidder can scalp the job by substitutions and alterations. And the principle applies to small work as well as large.

It would be a fine thing for the electrical contracting industry if we could establish the rule that there should be *"A wiring plan for every wiring job—a specification for every plan"*. And why not? Small jobs involve only small sketches, simple schedules of materials. But in every case, the benefits are all there. The owner and the contractor are both protected. And specifications can be prepared readily and with full assurance that they are complete, by following the simple guidance presented in the following pages.

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WIRING FOR RESIDENCES...APARTMENT HOUSES AND FARMS

RESIDENCES, apartment houses or farm-houses all serve the family and its daily needs for electricity. So they are grouped for discussion in this section. The other buildings on the farm, such as barns, chicken houses, milk house, sheds and workshop, are really nothing but small industrial plants. Certain motor applications, for example, may be best considered as power wiring. Farm outbuildings are included in this section only because it is impracticable to separate the farm house from these buildings and together, of course, they constitute a wiring system organized around this central unit.

Occasionally, of course, it will be found that a residence becomes so large that the provisions of this section only apply in part. The residence having a considerable number of motors and other equipment could at that point be classified as industrial. In this case, the recommendations of the industrial section also will have to be applied in order to obtain the best results.

In a very large apartment house development it will also be necessary to consult Section II. For in projects of this kind, secondary distribution systems will go beyond the scope of a dwelling house.

RESIDENCE WIRING

1. *Guiding Rules for Planning the Job*

When planning the wiring of a residence, approach the job in an orderly manner. Consider carefully the various features which make up the job and decide on them one by one. The following paragraphs cover the scope of a residence wiring system and will serve as a guide in your planning procedure.

A. GENERAL CONDITIONS

1. *Selection of Materials*

The selection of materials depends on two principal factors that should be considered separately in approaching any set of plans—

a. Local rules and regulations.
b. Type and structural design of residence to be wired.

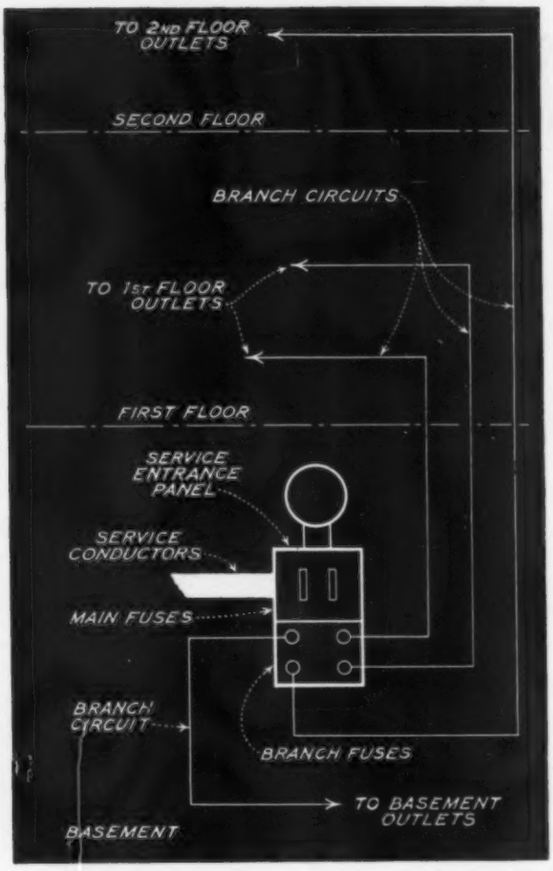
To present the job to the customer decide first, of course, if armored cable, non-metallic sheathed cable, conduit, tubing, or knob and tube wiring shall be used. Determine if fuses or circuit breakers shall be used, the type of switches and wall plates and the grade of all other wiring devices for the job.

2. *Grouping of Outlets*

It is good practice to install at least one circuit for each 500 ft. of floor area. In most cases, however, the job can be improved by grouping outlets so that two circuits reach every room, or arranging light and convenience outlets so as not to be controlled by the same fuse or circuit breakers. Because of loading conditions, certain circuits should serve only a very small number of outlets.

3. *Number of Circuits*

The number of circuits cannot be decided by standards alone. This is especially true in larger installations. The standard can only give recommendations which define good practice in normal cases. Frequently the grouping of outlets, special loading conditions and consideration for future additions make it advisable to install more circuits than seem necessary at first glance.



Example 1—CONVENTIONAL METHOD *of centralized residence load distribution and circuit routing.*

4. *Choice of System*

Wiring for residences is usually laid out according to one of two fundamental methods—

a. The conventional method, having all branch circuit breakers or fuses mounted with or without the main breaker at the point of service entrance.

b. The feeder method, in which subfeeders are installed leading from the main breaker or breakers or main fuse or fuses to branch panels located at convenient points throughout the house. This method is slowly gaining in favor because it offers many different ways of installing feeders to fit almost any condition.

For very small residences the system shown in Example 1 may be the best and most economical. For larger residences the feeder system of wiring is usually preferable (Examples 2, 3, 4, 5) since voltage drop and copper losses are reduced to a minmum.

B. INSTALLATION DETAILS

5. *Outlet Requirements*

The outlet requirements for the average residence are shown on pages 34 and 35. In using this listing, these additional rules should be carefully followed.

Rule A—In all major rooms, provide at least one convenience outlet for every 12 ft. of unbroken wall space, and at least one in each broken space 3 ft. or more.

Rule B—In halls, staircases, porches, terraces, install at least one convenience outlet for every 15 ft. of wall space.

Rule C—Provide 3-way and 4-way switches in rooms having two or more doors, in halls, stairways and for lighting circuits extending between buildings.

Rule D—Provide fixed lights in all rooms. If these are not used initially, they may be covered with a blank plate. In rooms over 400 square feet in area, or where the length is more than twice the width, or with very low ceilings, install two or more ceiling outlets. Also, consider cove, spot, soffit lighting.

6. *Determination of Circuits*

Four types of circuits are used in residence wiring—

a. Common Circuit—Each residence should have at least one 15 amp. branch circuit for each 500 square feet of floor area. When computing this area do not include unfinished spaces in basement, attic, open porches, or the garage, but the area must be computed from the outside dimensions of the house. When laying out the circuits, also add an extra load of 500 watts for kitchen and pantry, 500 watts for dining and breakfast room, and 500 watts for each receptacle adjacent to laundry tubs.

Provide a separate heavy duty circuit of No. 12 wire to kitchen, dining room and laundry. Include these circuits in calculating for other rooms.

b. Range, Water Heater and Motorized Appliances—The range and water heater, of course, must each have separate circuits, except in cases where these two appliances are interconnected by a double pole, double throw switch, or by a peak limiter. It is also strongly recommended that independent circuits be installed for all larger motorized appliances, such as refrigerator, dishwasher, or garbage disposal unit.

c. Bathroom Heaters, Pumps—Individual circuits should be provided for a 2500 watt heater in each bathroom, for the oilburner or automatic stoker, and for pumps, in case such equipment should be later installed. Outlets should also be provided over the work bench whenever a workroom is planned in the house or the garage.

d. Air Conditioning—If air conditioning equipment is installed, it must be provided with special circuits the capacity of which depends on the size of equipment used. The contractor should consult the air conditioning equipment manufacturer before deciding how many and what circuits to install.

In case portable air conditioning units are to be used, special circuits should be run to predetermined locations. They should terminate in polarized receptacles suitable for the probable size of the units under local regulations.

In many installations only a comparatively small part of the available equipment is used initially. For this reason not all of the circuits mentioned here may be necessary. However, the contractor who installs only the absolutely necessary circuits does himself and the customer poor service.

Therefore, in all cases provide a reasonable number of spare circuits in the panels for 115- and 230-volt service. A good practice in the average residence is to install at least two 15-amp. 115-volt spare circuits and one or two 230-volt circuits.

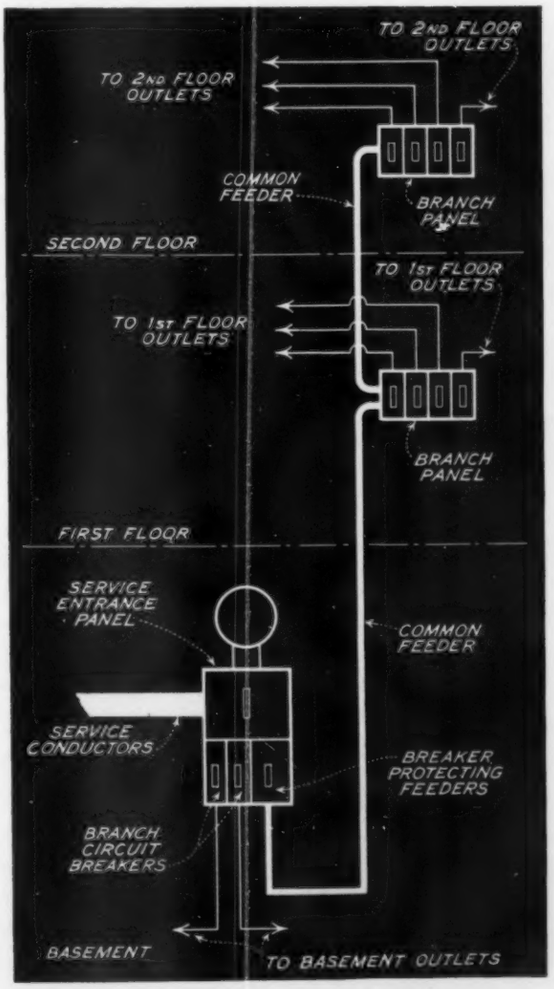
7. Service

According to the National Electrical Code, the service for a single family dwelling should be computed by assuming a load of one watt per square foot. For the first 2000 watts the demand factor should be 100, and for the excess over 2000 watts, the demand factor should be 60. In addition to this, 1000 watts should be allowed for small appliances and special appliance loads such as ranges and water heaters. The demand factor is 80 for one range.

Of course, these are minimum specifications based on safety requirements. They should be increased whenever possible. Guidance based on good practice will be found in the following table, in which all services are reckoned as 3-wire, 115-230 volt or 120-208 volts—

Minimum Safety Requirements

Floor Area of Dwelling	*Size of Service Conductors*	*Rating in Amperes*		
		Switch	*Fuse*	*Breaker*
Up to 1000	6	60	50	50
1000–1500	4	60	60	70
1500–3000	4	100	70	70
3000–4000	2	100	90	90



Example 2—FEEDER METHOD *for residence wiring design, employing branch panels at several locations.*

2. How to Specify the Job

As every electrical contractor knows, there are many essential elements which should be included in a specification for a single family residence. Listed in proper sequence they give a clear picture of the job. This makes for order in the progress of any job, large or small and avoids mistakes.

In reviewing here what should be included in a complete and orderly specification, it is not intended to give a master or sample specification, which can be copied direct. This is not practicable, because varying conditions in the job continually involve changes in the wording of the specifications. Rather, the purpose is to guide the contractor in writing his own specifications, or to give him better judgment in studying and checking specifications written by others.

A number of elements may be covered here, of course, which will not apply to the very small house. Similarly provisions, which might be needed in specifications for the very large house, may not be found here because they come more appropriately later in this section. In any specifications, however, the job should be divided between general conditions and installation details, as follows—

A. GENERAL CONDITIONS

1. Proposal

State necessity for a proposal in writing and explain that contract must be drawn in acceptance of this proposal on the basis of these plans and specifications.

2. Terms of Payment

Lay down the terms of payment. State precisely when and how you expect to be paid for the job and who shall pay you—general contractor or builder or owner.

3. Codes, Permit and Inspection

Since a great number of states, counties and cities have their own local ordinances, it has to be settled in the specification according to what laws or rules the installation should be executed and who should be the final inspection authority.

Define which inspection bureau shall have jurisdiction over the job and include the cost of permit and inspection certificate as part of the job. In localities where no local ordinances are in effect, state that you will obtain approval from the nearest Underwriters' inspection bureau.

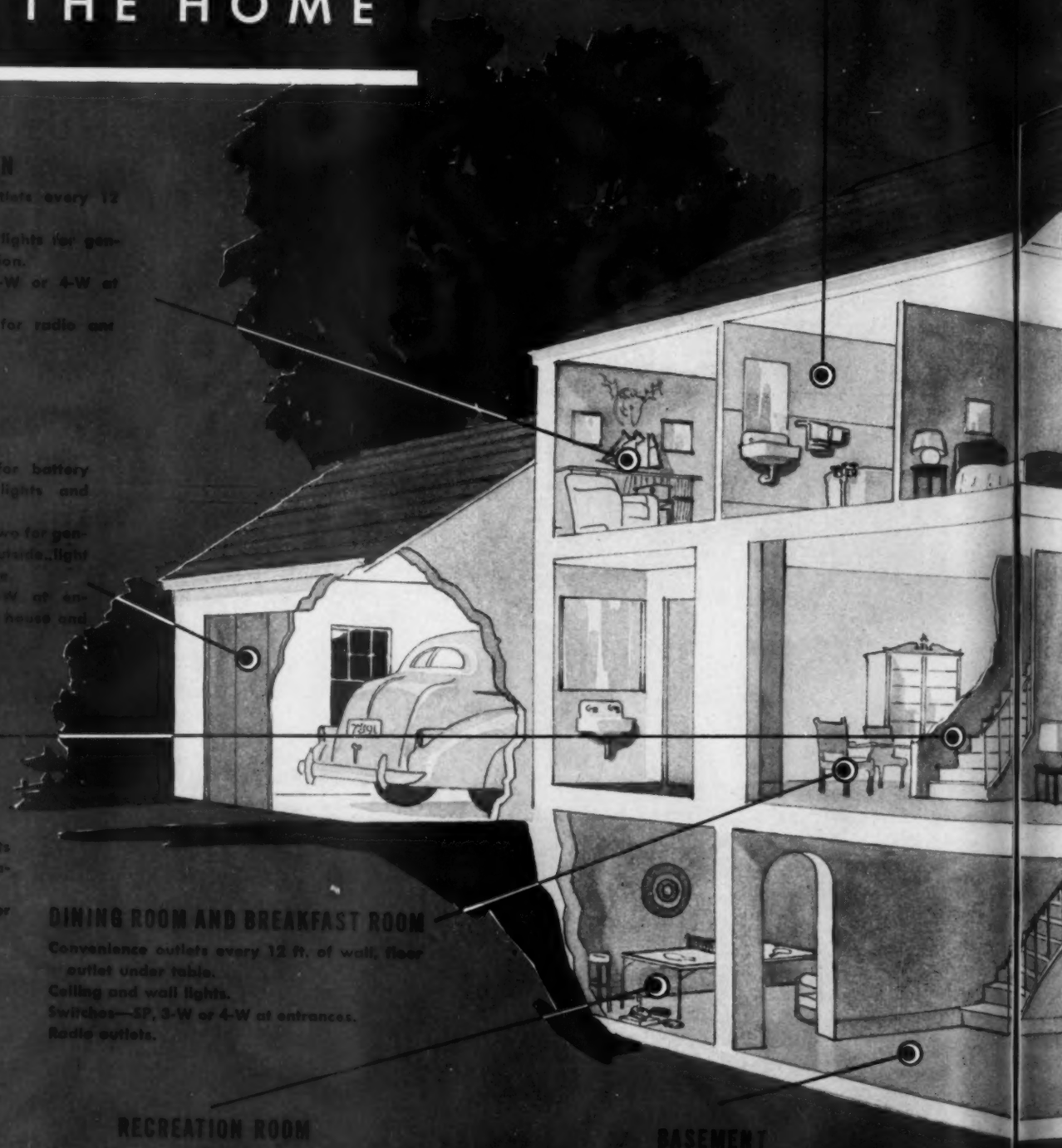
4. Material and Workmanship

Specify that all materials shall be new and that the materials shall conform with the standards of the Underwriters' Laboratories in every case, where such a standard has been established for the particular type of material to be installed. Also state that the work will be done in a workmanlike manner and will present a neat and mechanical appearance when completed.

5. Drawings

State that you consider the drawings a part of the specification and that they will be used accordingly. Also, state that you accept the plans and specifications as complementary each to the other and that what is called for by one shall be as binding as if called for on both.

Outlet Requirements for Adequate Wiring IN THE HOME



DEN

Convenience outlets every 12 ft. of wall.
Ceiling or wall lights for general illumination.
Switches—SP, 3-W or 4-W at entrances.
Special outlets for radio and clock.

GARAGE

Convenience outlets for battery charger, portable lights and tools.
Ceiling lights—one or two for general illumination; outside light over door of garage.
Switches—3-W or 4-W at entrances to light from house and garage.

HALLS AND STAIRWAYS

Convenience outlets every 15 ft.
Ceiling or wall lights for general illumination.
Switches—SP, 3-W or 4-W at entrances.

DINING ROOM AND BREAKFAST ROOM

Convenience outlets every 12 ft. of wall, floor outlet under table.
Ceiling and wall lights.
Switches—SP, 3-W or 4-W at entrances.
Radio outlets.

RECREATION ROOM

Convenience outlets every 15 ft. of wall space.
Ceiling or side lights for general illumination; local lights for ping-pong, billiards, cards.
Switches—SP or pull chain for all local lights; SP, 3-W or 4-W at entrances.
Special outlets for fan, clock and radio.

BASEMENT

Convenience outlets for equipment installed.
Ceiling or wall lights for all areas.
Switches—SP for all local lights; SP, 3-W or 4-W for at least one ceiling light, with pilot in kitchen.
Special outlets for heating plant, pumps, blowers, water heater, shop equipment.

ATTIC

Convenience outlets—at least one for general use.
Ceiling light for general illumination.
Switch—SP, with pilot light on floor below.
Special outlet for attic ventilating fan.

CLOSETS

Ceiling or wall lights.
Door switch and pull chain control.

MAIN AND SIDE ENTRANCES

Convenience outlets—WP, outdoors for decorative lighting.
Ceiling or wall lights—1 or 2 for general illumination.
Switches—SP for lights and outdoor outlets.
General outlets—pushbutton for door signal, illuminated house number.

BEDROOM AND DRESSING ROOM

Convenience outlets every 12 ft. of wall.
Ceiling lights for general illumination.
Wall lights—mirrors and night lights.
Switches—SP, 3-W or 4-W at entrances.
Master switch in master bedroom.
Radio outlet.

OPEN PORCHES

Convenience outlets, WP, every 15 ft. of wall.
Ceiling light or wall light for general illumination.
Switch—SP—inside porch entrance.

LIVING ROOM OR LIBRARY OR RECEPTION HALL

Convenience outlets every 12 ft. of wall and on mantel.
Ceiling or wall lights for general illumination.
Switches—SP, 3-W or 4-W at entrances.
Special outlets for radio and clock.

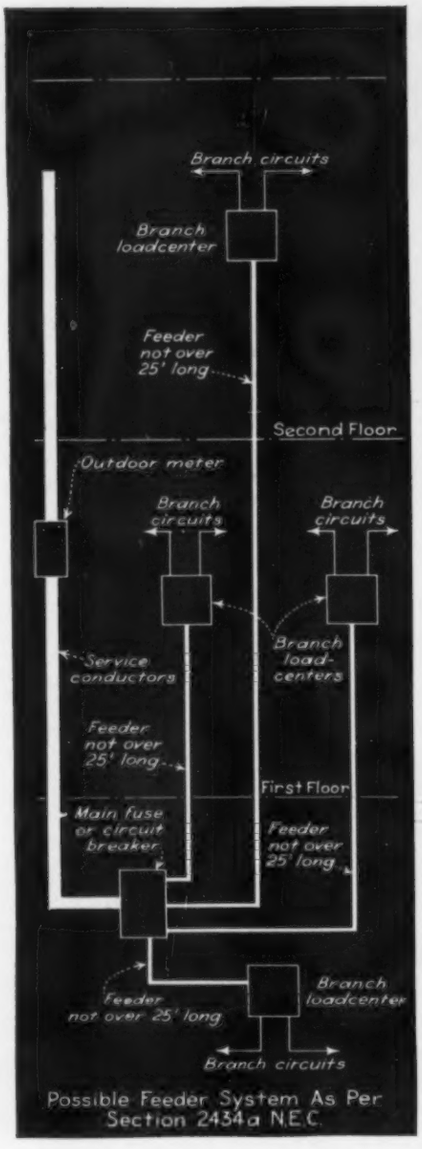
KITCHEN, PANTRIES

Convenience outlets for refrigerator, dishwasher, garbage grinder and over all work tops.
Ceiling light for general illumination; local lights—ceiling or wall—at sink, range and work tops.
Switches—SP or pull chain for local lights; SP, 3-W or 4-W at entrances for ceiling light.
Special outlets for range, fan, clock, radio and signaling devices.

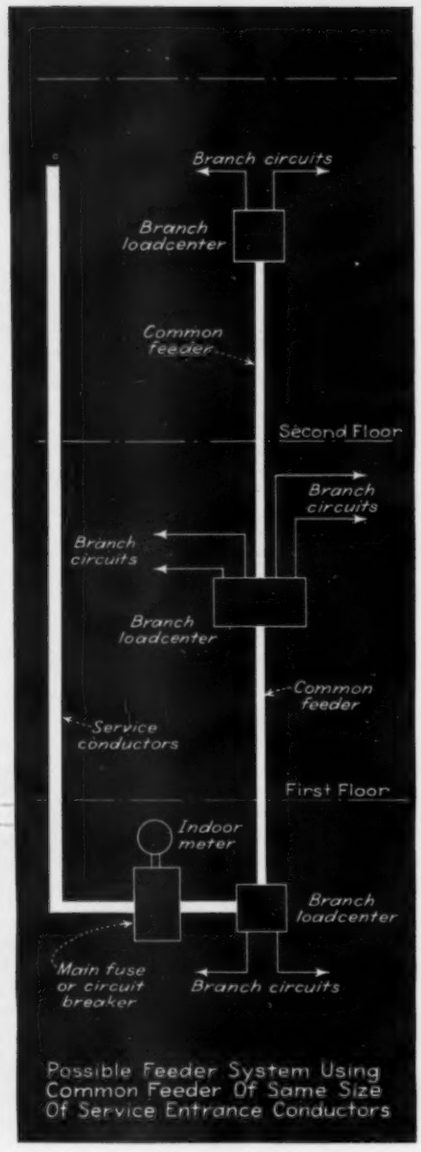
LAUNDRY

Convenience outlets—one for each work area.
Ceiling outlet for general illumination; ceiling or wall lights for washer, ironer, dryer, tubs.
Switches—SP for each local light; SP, 3-W or 4-W at entrances.

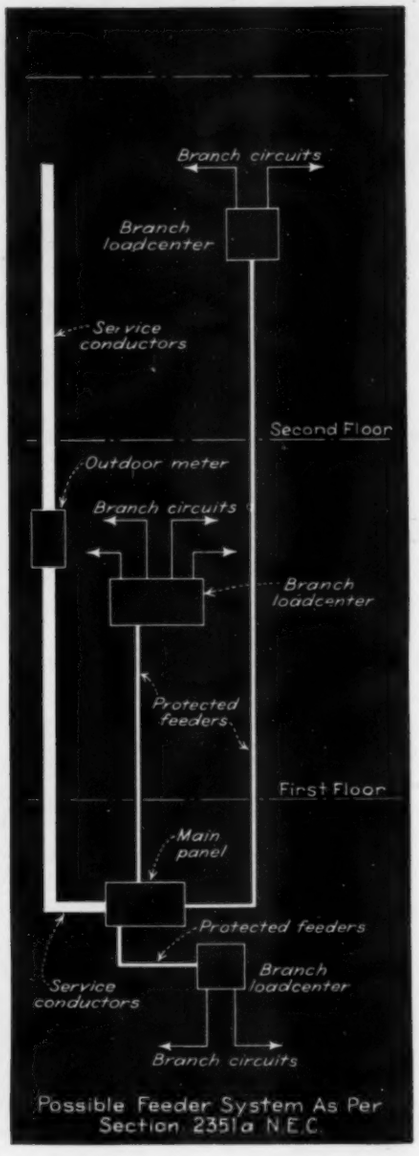
NOTE: For signaling and communication facilities see pages 39 and 40



Example 3—TAPPED FEEDERS, *not more than 25 ft. long, serve branch load centers in this residence layout.*



Example 4—COMMON FEEDER *serves separate load centers placed on each floor of the larger home.*



Example 5—PROTECTED FEEDERS *for each load center, require a main distribution panel in this layout.*

6. *Changes and Additional Work*

Stipulate that no changes shall be made except when authorized by the owner, and that payment is expected for changes or additional work.

7. *Liability Insurance*

State that only those contractors who carry and maintain insurance, conforming with the respective state laws, can be employed to do the job. This is vital, since the owner as well as the contractor are liable for damages caused in the execution of the work.

8. *Progress of Work*

Provide that the work shall be so arranged that it will not interfere with the other building trades. In rewiring jobs, set a time limit for the finishing of the job.

9. *Guarantee*

Give a guarantee that you will leave the entire electrical system in proper working order. Also, guarantee that any work or material, which develops defects, except for ordinary wear and tear within one year from the issue of the final inspection certificate, will be replaced free of charge.

B. INSTALLATION DETAILS

1. *Scope of Specifications*

Define in the specification which parts of the installation cover the furnishing of both labor and material and make a clear statement of the work which requires only the furnishing of labor. In addition, list all items to be included in the contract, such as the wiring for light, heat, power, signaling or telephone system, the furnishing and installing of all the equipment such as fixtures, ranges, electric heaters, oil burners, air conditioning equipment.

2. *Type of Wiring*

List the types of wiring to be used in general for the various portions of the installation. Material for service conductors, range circuit, branch circuit, and other special circuits to be installed must be defined as to type and size. Select materials which are in conformity with local rules and/or the National Electrical Code.

3. *Service Conductor and Feeders*

Define the type of service, in regard to voltage, size and number of service entrance conductors, and whether it is to be underground or overhead construction. The local utility company will advise you as to the type of service available, whether 115-230 volts or 120-208 volts. The location of the building and the owner's wishes will usually decide whether it shall be an underground or overhead service.

If feeders are to be used to branch panels, on the different floors of the house, state the size of these feeders, the method of installation and the material to be used. There are many approved ways to install feeders and the most satisfactory and economical method for this job should be selected and described.

4. *Service Equipment*

Describe the service equipment as either switch and fuse or circuit breakers. Add to this paragraph that the service equipment, methods of mounting and provisions for metering are in accordance with the service requirements of the local utility company.

5. *Branch Circuit Equipment*

The branch circuit equipment must be defined as fuses only, switches and fuses, or circuit breakers. State whether it is to be installed as an integral part of the service equipment, as a centralized panelboard, or as a number of small panelboards placed at convenient locations throughout the house. Describe each part of this equipment fully and, if possible, give the manufacturer's name and list his catalog number.

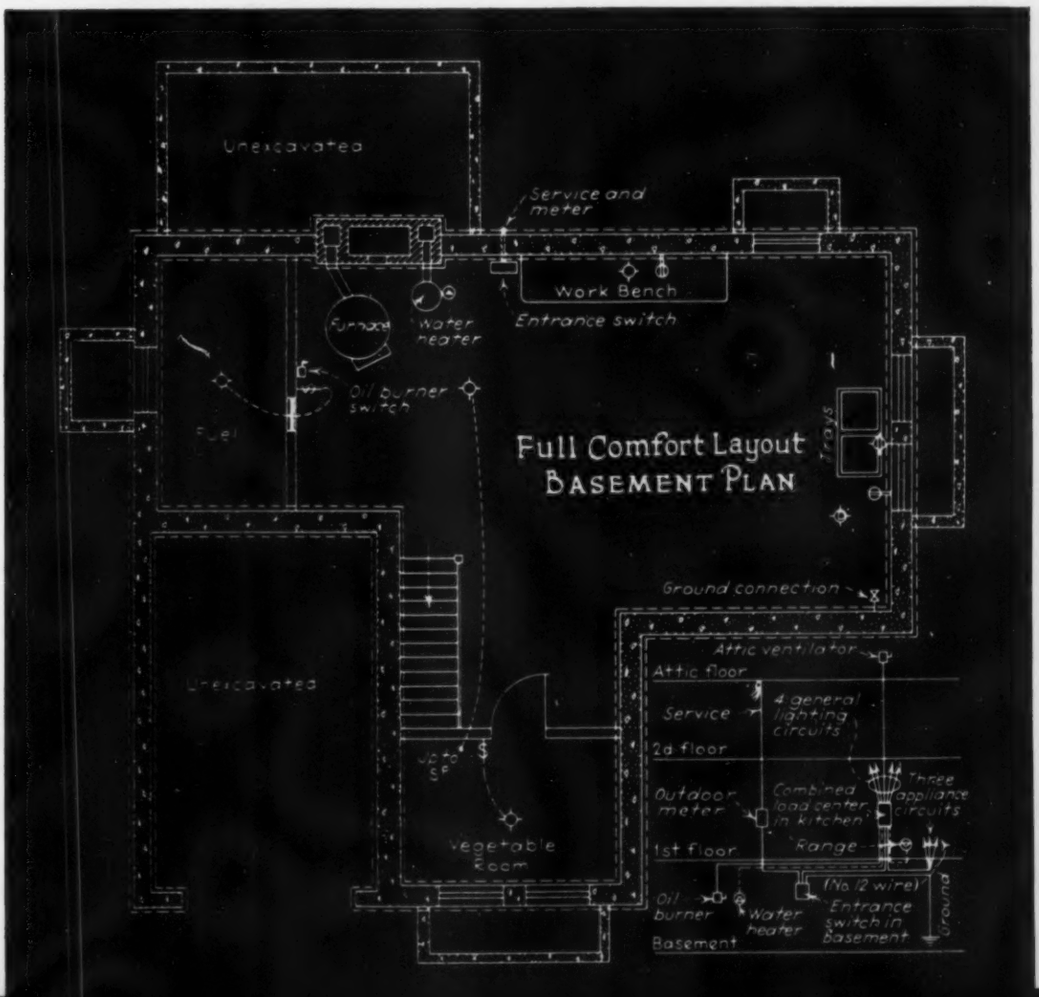
In cases where a number of small panelboards are used, make a regular panelboard schedule and state the location of the panelboards throughout the house. In larger houses, where a considerable number of special purpose circuits are installed, the branch circuit equipment will become somewhat complicated. For this reason panelboard schedules and detailed description forms are very important in the specification.

6. *15-Amp. Branch Circuits*

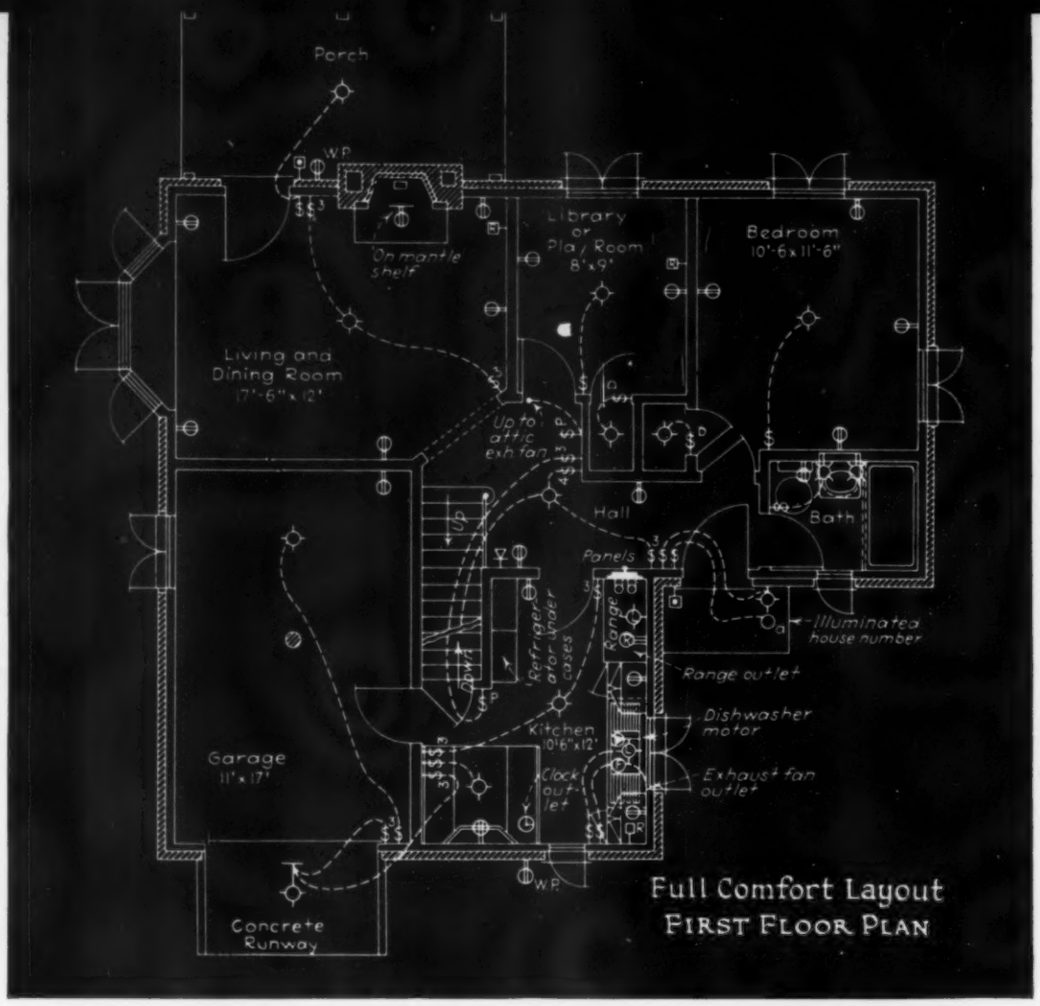
State the total number of 15-amp. branch circuits and define the type of lighting, switch and convenience outlets they will serve. Divide the outlets evenly among the circuits, as far as possible, and provide that the outlets in all major rooms will be divided between at least two circuits.

7. *Special Purpose Branch Circuits*

List all special purpose circuits, specifying each by wire-



Example 6—BASEMENT LOADS *are growing with mechanical equipment. Plan for liberal circuiting and specify the special outlets required here.*



Example 7. —COMFORT AND UTILITY *possibilities abound in first floor areas. Standards of adequacy need careful application to uncover extra features for the layout.*

size, number of conductors, and the number of outlets it shall supply. Include—

a. Circuit to kitchen for small appliance load
b. Circuits to refrigerator, dishwasher, garbage disposal unit
c. Circuit to laundry
d. Circuit to workshop
e. Circuit to water heater
f. Circuit to bathroom heater
g. Circuit to oilburner
h. Circuit to automatic stoker
i. Circuit to range
j. Circuit to air conditioning equipment
k. Circuit to pump motor

No special purpose circuit should be wired with less than No. 12 conductors. In many cases, where these circuits are very long, increase the size of the wire to No. 10 or more. Circuits to the water heater, pumps, and the air conditioning equipment depend largely on the size of the appliance used. The circuit to the range should not be less than three No. 6 conductors.

Clarify the specifications where it will be helpful. Describe the circuit itself and the equipment to be used. For example, oilburners and automatic stokers are usually supplied with disconnecting switches of special types. Pumps might require control equipment. These switches and controllers form a part of the special purpose circuit.

8. *Outlets and Wall Switches*

Cover the location of all wall outlets and switches. State that all outlets shall be installed in the locations, as shown on the plans. Make special reference to locations where interior finishes require extra care and accuracy in placing the outlets. Tabulate the height of bracket outlets and switches above the floor.

Make clear whether convenience outlets are to be installed in or above the baseboard. In work areas such as kitchen, pantry and breakfast-nook, locate them above work spaces. Outlets for clocks and fans should be about 7 feet above the floor, except in living room, where the clock outlet is often located in the fireplace mantel. Again the best location for washer and tub outlets is on the ceiling.

Where multi-outlet assemblies seem practical, outline the exact location of all devices. Give detailed information as to how they should be installed—in or on top of baseboard —and how many outlets per foot of the assembly.

9. *Master Switch Control*

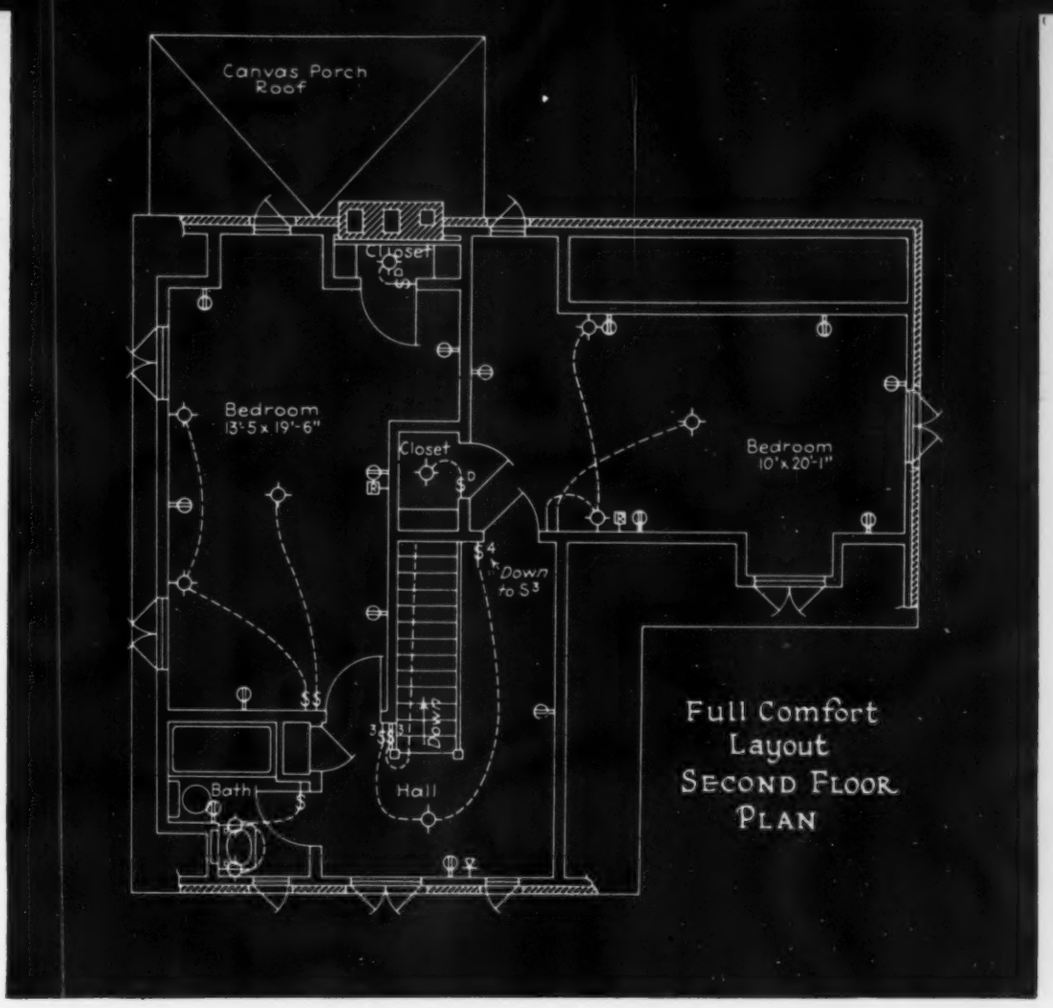
The outlets connected to a master switch should be so marked on the plans. The location of the master switch itself must be shown in the drawing and explained in the specification. Note if it should be equipped with a pilot light. Explain the circuiting in detail.

10. *Lighting Fixtures*

Include a schedule of lighting fixtures, defining type, quantity, wattage of lamps, finish and location. Also state who is to supply the fixtures.

11. *Electric Cooking and Heating Equipment, Motor-Driven Appliances and Electric Kitchens*

Draw up suitable specifications for the above equipment, including manufacturer's name and catalog number. State who is to furnish the equipment.



*Example 8—*ROOM LAYOUTS *for upper floors vary with size and architecture. Extra outlets, controls and special features suggest themselves during detailed planning.*

12. *Signaling Systems*

For small and medium size houses include push buttons at all entrances, of a design and finish to be approved by the architect. In the center of the dining room, specify a signal type receptacle with a hand or foot operating device, including plug and 6 feet of cord. The plug must be of such design that it cannot be used in standard convenience outlets. Specify braided rubber insulated wire, not smaller than No. 18 and all joints to be soldered and taped.

In the kitchen specify a buzzer for rear door, a bell for front door, and a mild tone single stroke bell for dining room, a multi-tone chime in hall. Install a bell ringing transformer.

In larger residences, where several servants are employed, specify flush wall type push buttons, ganged with the light switch or flush bell pull switch at the ceiling line, in the rooms as indicated on plans. A flush annunciator might also be specified to have an indicator for each calling station, with the drops properly lettered.

13. *Raceways for Telephone Service*

Where a number of telephones with a raceway system are to be installed, consult the local telephone company for a specification. However, the average requirements should be specified as follows:

Install from a point which can conveniently be reached by the telephone company, at a height not less than 10 feet from the ground, a ½-in. rigid conduit or electrical metallic tubing concealed in basement. The outer end of the raceway should terminate in a suitable weatherproof service head. Inside it should terminate in a steel box 8 in. x 10 in. x 4 in. From this box, conduit or tubing of size satisfactory to the local telephone company, should be run to all public telephone outlets.

The outlets can either consist of a standard outlet box with a wall plate, having a bushed hole for cords, or it can be a flush metal box of suitable size to contain the telephone ringer. For the size of the box consult the telephone company.

14. *Intercommunicating Telephone System*

Show the location of all telephones on the plans. The telephone should be the flush wall type with flush plates of a finish as approved by the architect or owner. Install a dry cell battery for talking and a transformer for ringing, and provide their special circuits. The wiring should be done with braided rubber insulated wire not smaller than No. 18. For systems larger than three to four telephones, consult the manufacturer for specification data.

15. *Radio Wiring*

If a number of radio outlets are to be installed, the antenna system becomes important, so that individual radio sets will not interfere with each other. Antenna wires should be kept as far away as possible from pipes and other wires and the entire system should be well grounded. If a special antenna system is to be installed, incorporate the specifications of the manufacturers of this system.

16. *Materials*

Tabulate all the types and grades of material which will be used in the installation. If possible specify by catalog numbers, since most manufacturers of wiring devices make

two or more grades of materials. The following items must be included—

a. Service entrance conductors—conduit and wire and cable
b. Service equipment—type and make
c. Feeder conductors—type of material
d. Branch circuit conductors—type of material
e. Branch circuit panel—type and make
f. Boxes and covers—type, finish and size
g. Switches—type, number of poles, and make
h. Convenience outlets—single, double, triple, polarized
i. Special outlets—description of each
j. Wall plates—material and finish

List all special materials and devices used, also important wiring accessories.

C. SUBMITTING THE PROPOSAL

After the specification is written and all the different phases and conditions of the entire installation have been covered and explained in detail, write a proposal. Make it as short, as precise, and as much to the point as possible.

The proposal is not part of the specification. It is only an offer to do the job at a certain price. But since a number of proposals may be submitted to the customer, yours should be so presented that it can be easily compared with others. A proposal which is vague in its contents or too long or mystifying in its form will very often be thrown out for just these reasons. List the following items in the proposal:

1. Total number of lighting outlets
2. Total number of switches
3. Total number of convenience outlets
4. Total number of special purpose outlets — with short explanation of the purpose of the outlet, such as range, water heater
5. Service entrance type—underground—overhead—size
6. Service entrance panel type—circuit breaker or fuses and number of circuits per panel and subpanels, in case they are used
7. Number of circuits—with short explanation of the special purpose circuits, such as range, water heater
8. Signalling systems
9. Type of wiring
   a. for service—such as conduit, service entrance cable, underground cable
   b. for special purpose circuits—such as conduit, armored cable, knob and tube, non-metallic sheathed cable
   c. for standard circuits—such as armored cable
10. Makes of wiring material—manufacturer's name

If all these items are listed, give total cost only—except where detailed estimates are especially requested. Add a guarantee covering workmanship and defective material, as recommended under the section on how to write the specification.

The one and only purpose of the proposal is to clinch the job. Therefore, all items which might increase its cost should be listed clearly. Include all the types of materials, which might make the job better, all the extra circuits and all the extra capacity which you intend to install. Make sure that your customer can compare your proposal with those of your competitors, who may figure the job based on bare necessities, on other materials and a different layout.

APARTMENT HOUSE WIRING

1. *Additional Planning Guides for Multi-Family Dwellings*

These recommendations for multi-family dwellings can be applied to two or four family houses, as well as to the average apartment house and to group housing projects. The latter consist in most cases of a number of small or medium size apartment houses, grouped together under common management and ownership. Normally, they present the same problems as any other apartment house project, except for the distribution system between the individual buildings.

The individual apartment can and should be considered as a private residence so that the guiding rules for planning the wiring and the specification procedure for private residences can be applied without any change. The wiring for each individual apartment will often be found somewhat easier than that for the private residence. The builder or owner will have to decide the electrical conveniences of all apartments and normally will want a good average condition only. Personal preferences for one fancy hook-up or the other encountered in private residences usually will not have to be considered. Therefore the guiding rules given here are additional data only and will not cover again the wiring of the individual apartment itself.

A. GENERAL CONDITIONS

1. *Selection of Materials*

The materials used in wiring apartment houses have to be very carefully selected. Three points should be taken into consideration—

a. Local rules and regulations
b. Structural design
c. Permanence and maintenance cost

Most larger apartment houses are usually of concrete construction. Therefore, roughing in material is limited to a raceway system, rigid conduit or electrical metallic tubing. For smaller multi-family dwellings, there is a larger variety of material available.

The contractor should always recommend materials which guarantee a permanent wiring job and low maintenance cost. The wiring devices used must be rugged, if they are to endure a series of changing tenants.

2. *Number of Circuits*

Follow closely the recommendations for private residences. But provide for more spare circuits in each panel. In apartment houses, the installation of additional circuits at a later date is extremely difficult.

The circuits on the main distribution center should also be considered carefully. Provide plenty of extra capacity. An apartment house is first of all a business property and as such must react quicker to changing conditions than the private residence. Extra capacity in main and sub-panels will make later changes feasible and less costly.

3. *Choice of System*

Feeders and sub-feeders can be installed in several different ways. Each has its own advantages for the particular job in question. For example, all meters may be located at a central point and feed all apartments separately. Or, heavy feeders may run to the foot of each tier of apartments, with the meters there, to feed the apartments separately from this point. Or, heavy feeders may run up to the top floor and branch off these feeders to the individual apartments having the meters in each apartment, or again, they may be arranged in small groups in the public hall on each floor.

Where the cost of current is part of the rental, a well laid out feeder system will look quite different than in the case where the tenant pays for the current. Or the addition or omission of electric ranges might change the entire feeder system from the ground up, both as to the size of feeders and their routing and location. So no wiring job in any apartment house should be started before all these points have been settled.

B. SPECIFIC CONDITIONS

1. *Determination of Feeders*

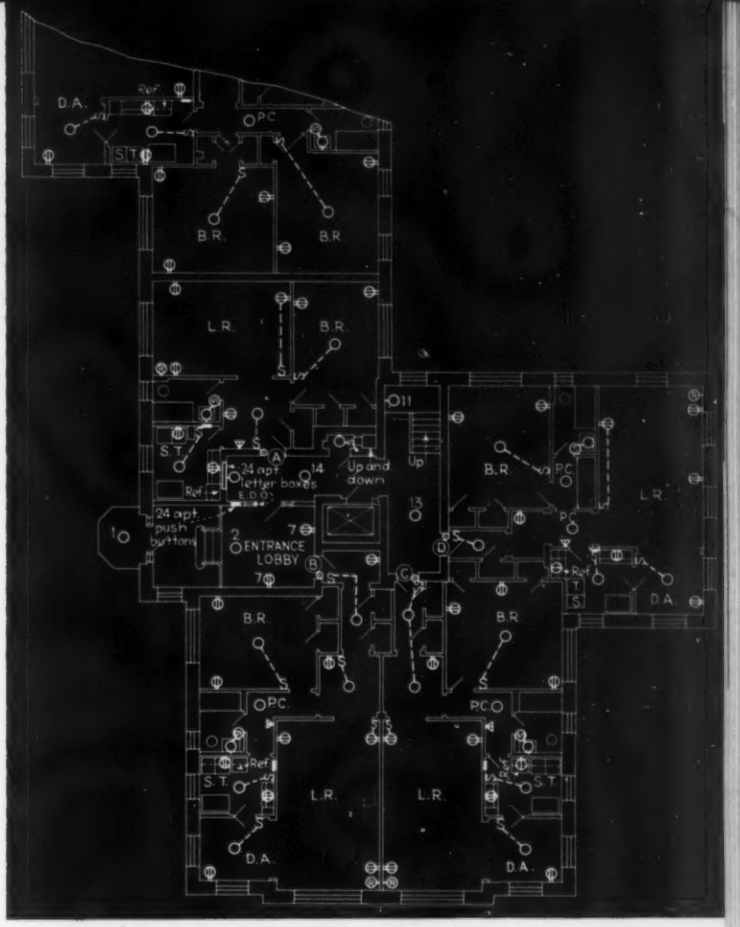
To determine the number of feeders, their size and location, assume a lighting load of two watts for each square foot of floor area and 1000 watts for small appliances in each apartment. After the load for the single apartment has been settled, the demand factor permitted by the Code can be applied.

If ranges are to be installed, the rated capacity of all ranges on one feeder must be added together and then the demand factor of the Code can be applied to the total. All other loads, such as lighting in public halls or storage spaces, and the loads for power and heater demands, shall be calculated and feeders must be large enough to carry the intended load.

Aside from the current carrying capacities of the feeders, the matter of voltage drop must be taken into consideration. The total voltage drop to any sub-panel should not be more than 2 per cent and the drop from service equipment to the range should not exceed 2½ per cent. In larger apartment houses these voltage drop calculations may increase the feeder size considerably.

Example *for feeder calculations in an apartment house, not including demands for motor equipment and wiring in non-rentable spaces.*

The feeders to be calculated for an apartment house having 32 apartments. Each apartment has a floor area of 1000 square feet and is equipped with an 8000 watt electric range. The meters are installed in four banks of 8 each at the foot of each tier. Voltage drop is not being considered.



Example 9—APARTMENT CONVENIENCE *requirements are like those in the home. Layouts are usually standardized for many suites, as in this partial floor plan.*

Sub-feeders for each apartment

Lighting load (1000 x 2 = 2000 watts)
2000 watts at 100% = 2000 watts
Small appliance load = 1000 watts
Total load without range = 3000 watts
Range 8000 watts at 80% = 6400 watts
Total computed load 9400 watts

For 115-230 volts, 3-wire service the sub-feeder to each apartment will be 9400 ÷ 230 = 40.8 amp. or No. 6 wire.

Feeders from service equipment to meter bank

Lighting load (8 x 1000 x 2 = 16,000 watts)
2000 watts at 100% = 2000 watts
14,000 watts at 70% = 9800 watts
Appliance load
Small appliances (8 x 1000 watts)
8000 watts at 70% = 5600 watts
Ranges (8 x 8000 = 64,000 watts)
64,000 watts at 36% = 23,040 watts
Total computed load 28,640 watts

For 115-230 volts, 3-wire service the feeder to each meter bank will be 28,640 ÷ 230 = 124.5 amp. or No. 0 wire.

Main Feeder (32 Apt. with 32 ranges)

Lighting load (32 x 2000 x 1 = 64,000 watts)
2000 watts at 100% = 2,000 watts
62,000 watts at 60% = 37,200 watts
Appliance load (32 x 1000 = 32,000 watts)
32,000 watts at 60% = 19,200 watts
Ranges (32 x 8000 = 256,000 watts)
256,000 watts at 22% = 56,320 watts
114,720 watts

For 115-230 volts, 3-wire service the main feeder will be 114,720 ÷ 230 = 499 amp. or 700,000 circ mills.
On the portion of the load over 200 amp. the size of the

neutral feeder can be reduced by applying a further demand factor of 70%.

Maximum unbalanced load 499 amp.
200 amp. at 100% = 200 amp.
299 amp. at 70% = 209.3 amp.

Computed neutral feeder load 409.3 amp.

The size of the neutral feeder will have to be *600,000 circ mills if insulated or 350,000 circ mills if bare*

It follows that the main feeder in accordance with this calculation could be

2 conductors 700,000 circ mills insulated and
1 conductor 600,000 circ mills insulated
or
2 conductors 700,000 circ mills insulated and
1 conductor 350,000 circ mills bare

2. *Determination of Service and Subpanels*

Determine the type and size of equipment to be used for the main panel and the subpanels. The main panel may be installed in connection with the meter equipment—especially in smaller projects—or it may be entirely separated from it. Decide if meter test equipment is required. Where the main panel includes feeder distribution equipment, provide for one or two extra feeder circuits. The local utility should be consulted before final decision is reached on the equipment.

Where subpanels control a number of apartments, the total computed load will give data for selection.

All panels—main sub and branch—should have their circuits clearly marked. Whether fuses or breakers are used in the branch panels, the same protective method should be used throughout, or vice versa, because of the difference in time lag between breaker and fuse.

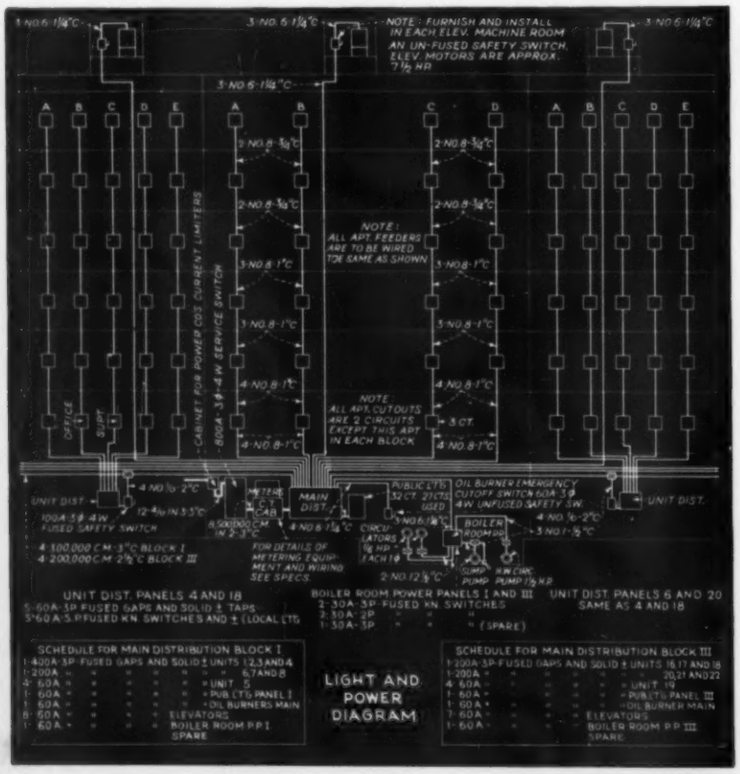
3. *Selection of Signaling System*

In very small apartments provide simple signaling systems listed under residence wiring. In larger buildings install a call and speaking system from each apartment to the vestibule and to the superintendent's office. Where a separate tradesmen's entrance is involved a similar system should be installed from this location to each apartment.

Where an attendant is continually on duty, a call and speaking system should be installed so that he can talk with each apartment and with the superintendent.

The telephone service should be installed according to the rules and regulations of the local telephone company.

Example 10—GROUP HOUSING *makes apartment design technique a combination of residence outlets and important service load considerations. This partial riser diagram suggests the detailed engineering involved.*


NOTE: FURNISH AND INSTALL IN EACH ELEV. MACHINE ROOM AN UN-FUSED SAFETY SWITCH. ELEV. MOTORS ARE APPROX. 7½ HP.
NOTE: ALL APT. FEEDERS ARE TO BE WIRED TOE SAME AS SHOWN
NOTE: ALL APT. CUTOUTS ARE 2 CIRCUITS EXCEPT THIS APT IN EACH BLOCK
CABINET FOR POWER COS CURRENT LIMITERS
800A-3Ø-4W SERVICE SWITCH
OFFICE
SUPT.
MAIN DIST.
PUBLIC LTS 32 CT. 27 CTS USED
OIL BURNER EMERGENCY CUTOFF SWITCH 60A-3Ø 4W UNFUSED SAFETY SW.
UNIT DIST.
BOILER ROOM PP
CIRCULATORS ½ HP 1 EACH
SUMP PUMP
RW CIRC. PUMP 1½ HP
FOR DETAILS OF METERING EQUIPMENT AND WIRING SEE SPECS.
UNIT DIST. PANELS 4 AND 18
5-60A-3P FUSED GAPS AND SOLID ± TAPS
5-60A-3P FUSED KN SWITCHES AND ± (LOCAL LTS
BOILER ROOM POWER PANELS I AND III
2-30A-3P FUSED KN SWITCHES
2-30A-2P " " "
1-30A-3P " " " (SPARE)
UNIT DIST. PANELS 6 AND 20 SAME AS 4 AND 18
SCHEDULE FOR MAIN DISTRIBUTION BLOCK I
SCHEDULE FOR MAIN DISTRIBUTION BLOCK III
LIGHT AND POWER DIAGRAM

2. How to Specify the Apartment House

On specifications for small and medium sized apartment buildings, follow closely the outline recommended for residential wiring. The division of the specification into general conditions and installation specifications is just as necessary here as it is on residential buildings. But in writing the apartment house specification, it may be well to elaborate many paragraphs. The size of the project and the conditions will dictate how far to go.

When specifications for multi-family dwellings present extraordinary problems in lighting or motor equipment, look for guidance to the sections dealing with commercial, industrial, and factory buildings. These cover special conditions in lighting, power wiring and signaling systems that will be helpful.

The general conditions which the specification has to cover can be divided into 10 paragraphs as follows:

A. GENERAL CONDITIONS

1. *Index of Specification*

Define precisely what the specification covers. State the size of the entire project, the number of apartments, the number of buildings. Cover all the special wiring which may be necessary, such as wiring for public halls, staircases, store rooms and wiring for motor equipment, such as elevators.

2. *Proposal*

See Residential Wiring, Page 33 Section 1.

3. *Terms of Payment*

See Residential Wiring, Page 33 Section 2.

4. *Codes, Permit and Inspection*

See Residential Wiring, Page 33 Section 3.

5. *Drawings*

Much more detail is required than on a residential job. Cover the general layout of outlets and switches, and show a detailed riser-diagram and a precise layout of the circuits. Include in the drawings, wiring diagrams of all special equipment to be installed such as antenna systems, signaling systems.

6. *Materials and Workmanship*

See Residential Wiring, Page 33 Section 4.

7. *Changes and Additional Work*

See Residential Wiring Page 36 Section 6.

4. *Radio Wiring*

It is strongly advised that in all multi-family dwellings a radio antenna system should be installed. In general, there are two different types of antennae systems available. One employs a separate antenna wire for each wave band, couplers and an amplifier and any number of sets can be connected. The other system employs couplers and an antenna transformer and can be used for the connection of 20 to 25 sets to an aerial. The installation instructions of the manufacturer should be closely followed.

8. *Liability Insurance*
See Residential Wiring Page 36 Section 7.

9. *Progress of Work*
See Residential Wiring Page 36 Section 8.

10. *Guarantee*
See Residential Wiring, Page 36 Section 9.

B. INSTALLATION DETAILS

The installation specification for the average multi-family dwelling can be subdivided in the following 16 articles. But in cases where special conditions have to be taken care of, further paragraphs to cover these conditions must be added. Similarly in some simple jobs one or more of these articles can be omitted.

1. *Scope*
List all the wiring to be included in the specifications, for instance, light, power, signaling systems, emergency system. State for which part of the installation material and labor will be supplied, and for which part labor only.

2. *Types of Wiring*
See Residential Wiring, Page 37 Section 2 and add details where necessary.

3. *Service Entrance Conductors*
Define the following two points for each service entering the building.

a. *Location*—overhead, underground, point of entrance.
b. *Material*—number and size of wires, type of insulation, conduit, service entrance cable, underground cable.

Before settling these details, consult the local utility.

4. *Service Equipment*
See Residential Wiring, Page 37 Section 4 and add details where necessary.

5. *Feeders*
Prepare a feeder schedule giving size and type of conductors, whether they will be cable assemblies or to be run in a raceway and size of raceway. Add to each feeder description the number of connected units and panel location.

6. *Feeder Distribution Centers*
List and locate and describe all feeder distribution centers to be installed. For smaller installations panelboards may be sufficient. For larger installations switchboards may be required. Describe in detail what you expect to install and if possible give manufacturer's name and catalog number.

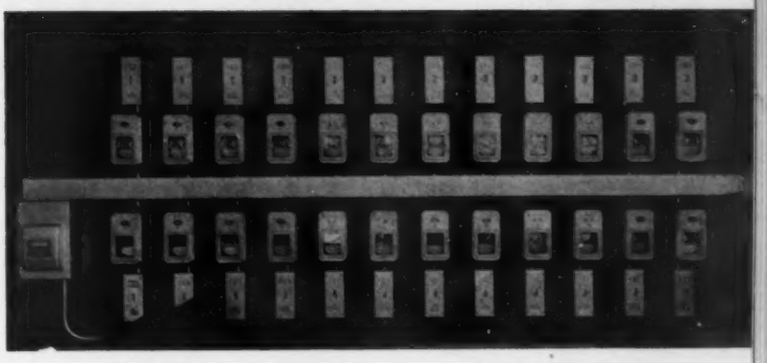
7. *Panelboards*
Prepare a detailed panelboard schedule, listing each panelboard separately and its location. Also give all available information on the size and number of mains and the type of connections. Include number of circuits per panelboard, type of circuit protective devices—circuit-breaker—fuses—and general mounting information, such as, flush or surface.

8. *15-amp. Branch Circuits*
See Residential Wiring, Page 37 Section 6.

9. *Special Purpose Branch Circuits*
See Residential Wiring, Page 37 Section 7

10. *Outlets and Wall Switches*
See Residential Wiring, Page 38 Section 8.

11. *Materials*
See Residential Wiring, Page 39 Section 16.



APARTMENT METERING *layouts vary with the number of families and in various factors of adequacy. Workmanlike installations, like this, are the result of planning and specifying all details to make electric service right for frequently changing tenants.*

But since materials of higher grade and longer life are required, go into great detail, describing each type of material used in the building.

12. *Lighting Fixtures*
Make the schedule very detailed. Should standard types of fixtures be used, give the catalog number of one or more manufacturers. Describe special fixtures in separate paragraphs. Information should include data on number and size of lampholders, control, lamp wattage, reflector or globe, hanger and finish.

State also who shall furnish the fixtures. Describe what type of work and how much the contractor is to do in connection with the installation of the lighting equipment.

13. *Special Equipment*
For electric cooking and heating equipment and motor driven appliances, see Residential Wiring, Page 38 Section 11.

For motor equipment for elevators or pumps, see sections on commercial, industrial and factory buildings.

14. *Signaling Systems*
See Page 60 on signaling and communication.

15. *Telephone Raceway System*
See Residential Wiring—Page 39 Section 13. Also consult local telephone company before final specification is drawn.

16. *Radio Wiring*
Include the specifications of the respective manufacturer supplying the material for the radio antenna system.

C. SUBMITTING THE PROPOSAL

While the proposal for the private residence can be made very short—See Residence Wiring Page 40 Section C—that for the wiring of an apartment house will usually be a document of several pages.

List in detail the various parts of the installation. Explain special circuit and wiring conditions more carefully. Motor circuits, with their control equipment, need step by step description.

The ten items listed under Residential Wiring—Page 40 Section C—will usually cover the need with the addition of items on feeder distribution centers, lighting fixtures, and power circuits. Usually the job will be awarded on the proposal, so explain in the proposal the reasons for increase in cost wherever such reasons exist. Explain where your job will be better than average. Keep the proposal as short, precise and clear as possible.

WIRING FARM BUILDINGS

1. *Additional Planning Guides for Farm Wiring*

Electrical equipment used on the farm is much like that of any other wiring job, but the farm wiring layout is special and the wiring materials used may be different. Treat the farm house itself substantially the same as in other residential wiring. Consider the other buildings on the farm—the barn, milkhouse, granary, chicken coop, hoghouse—as similar to small industrial occupancies.

Most farms to be wired consist of finished buildings, not connected to a continuous city water system. So grounding facilities are poor.

Follow this planning guide and specification procedure for the average farm only. For smaller or larger farms, obvious omissions and additions to these recommendations must be considered.

A. SELECTION OF MATERIAL

The selection of material for the farm wiring job is dependent on the conditions found on the farm. The material used in the farm house itself can be almost any type approved by the Code. The most important questions are—

1. Choice of materials best suited for operating safely under the poor grounding conditions prevailing on most farms.
2. Prevention of stray currents which might injure live stock.
3. Resistance to the moisture and ammonia fumes present in barns.

B. DISTRIBUTION SYSTEMS

A farmstead consists of a number of buildings, so it is necessary to install a secondary distribution system, to supply power to all these buildings. To lay out such a distribution system, make a sketch of the building group. Set down roughly the light and power requirements for each building and do not make the mistake of considering present needs only. It is almost certain that the electrical needs will increase considerably in a very few years. Then determine the distance between the buildings.

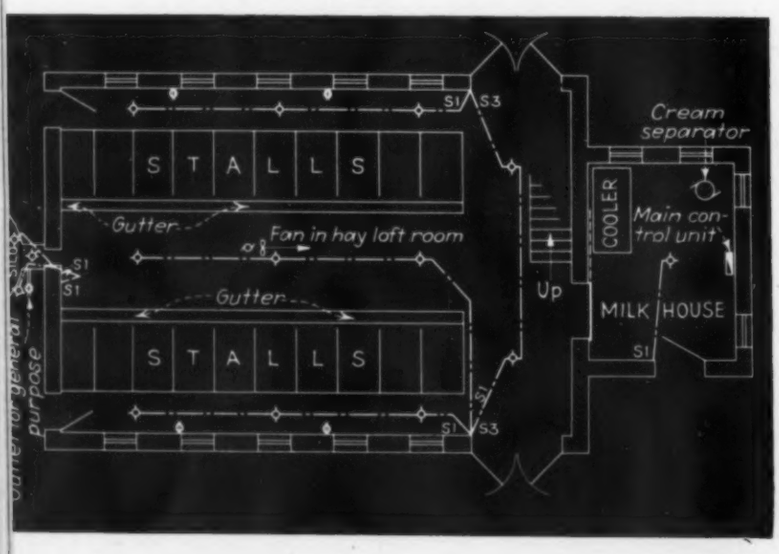
After this map is made, settle the location of the main switch as centrally as possible, but not too far from the highline. If there is a building near the selected spot, the main switch and meter can be located in or on the outside of it. If not, a pole should be set and the meter equipment and main switch installed on this pole.

The load for each building having been settled, it is a simple matter to calculate the size of the feeders from the center pole or centrally located building to the other farm buildings. Use separate feeders wherever possible to each individual building. Make the load in any one building entirely independent of the loads in all other buildings, so that the load in one building can be increased without affecting the entire farm layout.

In some farm layouts, it also may be economical to erect a second pole at a conveniently located point. In this case the first pole would carry the entrance equipment, some feeders to some of the buildings and a subfeeder to the second pole. The second pole would be the distribution center for all the buildings near it and would carry the feeders which serve these buildings.

In some localities, the center pole is often used as a transformer pole also. Then the main feeder, of course, runs only from the top of the pole down to the meter and main switch and back up again to the splicing point. When the transformer is mounted on a separate pole, some distance away from the center pole, the matter of voltage drop must be considered. Limit the voltage drop to 1 per cent from transformer to main switch and 1 per cent from center pole to the service equipment in each building.

Example 11—LOCAL DETAILS *are necessary to support a well-planned layout in larger farm buildings. It is good selling that impresses the customer.*



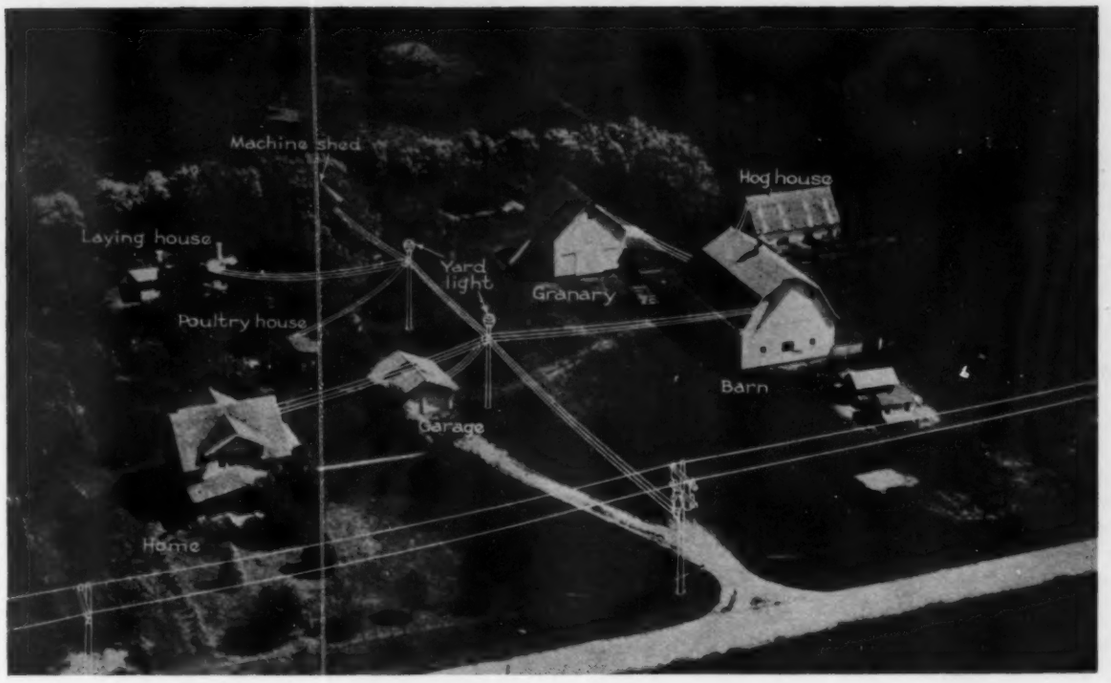
C. WIRING THE FARM HOUSE

One special condition must be considered, that is not encountered in the ordinary house. Usually farmhouses to be wired are not newly constructed buildings. Take this into consideration in planning the outlet and circuit layout. Otherwise follow the recommendations in Residential Wiring. Page 31 Section 1.

D. WIRING THE OTHER FARM BUILDINGS

Farms vary so widely that it is impossible to find a common wiring standard to fit any type of farm or all the buildings which are to be wired. A dairy farmer's electrical needs are different from the needs of a truck farmer, a sheep ranch will have other requirements than a citrus fruit grower, because they have different functions to perform.

Electrical appliances and machinery are available to do almost any kind of farm work, beyond the scope of this section. Buildings which serve a special purpose must be wired for this purpose; and as in all other buildings, the layout is controlled by the functions of that building only.



FARM FEEDER *spans are like the layouts for small industrial yards. Plot sketches and specifications should show the owner that future needs are covered and provide the power that he requires—with security and without unnecessary future alteration expense.*

In the major buildings, however, the requirements are—

1. *Dairy Barn*

A row of ceiling lights over the center of each alley, spaced not more than 15 feet apart with switch control on each entrance.

One switch controlled ceiling outlet in each stall.

One row of convenience outlets behind each row of stalls, where portable milking machines are used. These outlets should not be more than 20 feet apart, but this spacing may be 30 feet, where a pipe line milking machine is used.

One heavy duty weatherproof outlet outside for hay-hoist motor.

One ceiling outlet for light in center of hay mow with switch on main floor.

2. *Silo*

One outlet each on bottom and top of chute with separate switch for each.

One heavy duty weatherproof outlet to operate ensilage cutter motor.

3. *Milk House*

One ceiling outlet in center of each room, with switch control.

Convenience outlets for connecting separator, churn, refrigerator.

Suitable wiring for fixed equipment, such as compressor motor and agitator motor.

4. *Poultry House*

One row of ceiling outlets spaced not more than 12 feet apart. And an automatic time switch is better than a hand operated switch.

5. *Shop*

One switch controlled ceiling outlet for general illumination.

Ceiling outlets for the work bench, over each piece of equipment.

At least two convenience outlets over the work bench, not more than 6 feet apart.

6. *Pump House*

One ceiling light with switch control for general illumination.

One convenient outlet for general purpose use.

Do not connect grounds to the water pipes, on account of the danger to cattle. Use separate driven ground rods throughout.

7. *Yard Lighting*

Install yard lights wherever they will be useful and provide switch control at the house, barn, and other places convenient for the owner. The centerpole is often used for yard floodlights.

E. SELECTION OF SERVICE AND SUB-SERVICE

When the total connected load has been determined in each building and all these loads have been added together, the main switch can be selected for the type and size. It is impossible to give a diversity factor for farm buildings in general, so the contractor must decide how large it should be. Service equipment should never be less than 3-wire 100-amp. except in very small farms. Consult the

local utility and follow prevailing practice and requirements.

The size of the sub-service in the various buildings depends, of course, on the connected load. Locate the service near the entrance of each building. The panelboard itself often can be used as disconnecting means for the various circuits. If so, use panelboards with switch and fuse or with circuit-breakers for branch circuit control.

Recommend panels with a reasonable number of spare circuits, as the load will increase as new uses for electricity for the farm are developed. Also, spare circuits simplify the moving of equipment to other locations.

2. How to Specify the Farm Job

Since a farm is a combination of a residence and a number of industrial buildings, it is necessary to write specifications for the house, and the "industrial" buildings, barn, shop, milkhouse, in addition to covering the section on the general wiring. There is also the outdoor wiring which must be described. Include these points differing from the ordinary residential wiring specification.

A. GENERAL CONDITIONS

1. *Scope of Specifications*

Tabulate what the specification shall cover. List all the buildings to be wired, the outdoor wiring and whether the specification includes labor and material or labor only. If necessary go into more detail as explained under Residential—Page 33 and Apartment House Wiring Page 43.

2. *Type of Wiring*

See Residential Wiring, Page 37 Section 2.

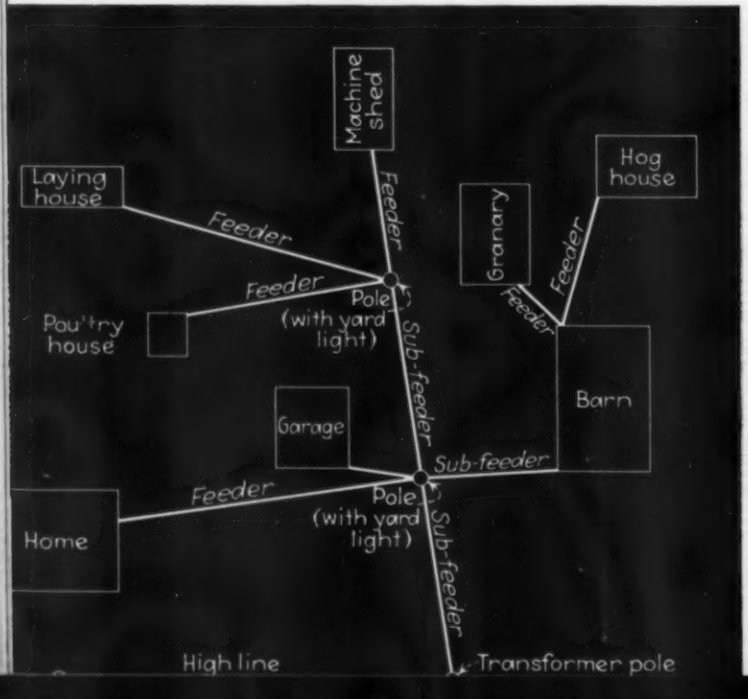
B. INSTALLATION DETAILS

1. *Service Conductors and Feeders*

Make a feeder schedule and feeder diagram. See example 12. List all feeders according to size, number of conductors and location from point to point. Specify the type of material for feeders whether underground or overhead.

Describe the size and number of service conductors.

Example 12—FARMSTEAD ADEQUACY *depends on calculating feeders liberally for scattered loads. This plot sketch is the foundation for planning the farm system.*



Consult the local power company on the type of service to be supplied.

2. *Service Equipment*

See Residential Wiring, Page 37 Section 4.

Cover main switch and fuse or main circuit breaker, controlling all the feeders to the different buildings. The local power company will advise regarding the type of material and its location.

3. *Panelboards*

There are usually separate service entrances, installed in the individual buildings. State number, size, type and location and method of grounding. Otherwise follow the paragraph on panelboards for the apartment house. See Page 43 Section 7.

4. *Fifteen-amp. Branch Circuits*

See Residential Wiring—Page 37 Section 6. Describe all 15-amp. branch circuits in each building.

5. *Special Purpose Circuits*

See Residential Wiring, Page 37 Section 7.

List and describe all additional special motor circuits. Since these motor circuits are entirely different from the usual 15-amp. branch circuit heavy duty appliance circuits, list size of wire, type of control equipment and capacity of circuit and outlet.

6. *Outlets and Wall Switches*

See Residential Wiring, Page 38 Section 8.

7. *Materials*

Tabulate material to be used for each building. Select materials to withstand abuse or hazards present.

8. *Lighting Fixtures*

See Residential Wiring, Page 38 Section 10.

9. *Special Equipment*

See Residential Wiring, Page 38 Section 11.

10. *Yard Lighting*

Where a number of yard lights are required, with switch control from different points, make a diagram of the yard-lighting layout. State if wires shall be run underground or overhead, number of switches, type of fixtures, wattage of lamps, and number of posts to be erected. If yard lights are far apart, make allowance for voltage drop in the size of the conductors.

Describe the location of the poles, lights, switch controls and wattage for each light.

11. *Signaling System*

See Residential Wiring, Page 39 Section 12.

12. *Telephone System*

See Residential Wiring, Page 39 Section 13–14.

13. *Radio System*

See Residential Wiring, Page 39 Section 15.

C. SUBMITTING THE PROPOSAL*

Follow the outline and consider all items listed in Residential Wiring—Page 40. Add details on motor circuits and sub-service in each building. Summarize the entire installation in short words and inform the owner what the job will cost him.

Remember that the farmer as a rule, is not familiar with electric wiring and trade names commonly used by electrical men. Word the proposal so that the farmer can understand what you intend to do.

WIRING COMMERCIAL . . . INSTITUTIONAL AND FACTORY BUILDINGS

THE preparation of plans and specifications for commercial, industrial, and factory buildings presents a similarity of problems. Therefore they will be discussed together here. The contractor must select the recommendations which fit the particular building which he is to lay out and wire.

The main difference between the wiring of commercial, industrial and factory buildings and wiring for the residence, farm or apartment house lies in the heavy equipment used and the permanent location of the equipment. In residences, each outlet, no matter where it is located, might be used for almost any electrical appliance in the house. The number of fixed appliances such as range and waterheater, is small. In industrial buildings just the opposite is true. Most of the equipment is fixed and the moving of it can only be accomplished with some changes in the wiring. The number of portable appliances or motors is comparatively small.

While in the average residence or farm the heaviest motor to be found will be 7½ to 10 h.p. there is no limit to the size of machinery in a factory.

Heating equipment in residential occupancies hardly ever has a rating of more than 10/16 k.w. per unit. But industrial heating equipment may run to many times this rating. Therefore, in many cases the problem is not only to connect the equipment but the selection of the proper voltage which may be anywhere from 120 to 6600 volts—and the selection of the system such as 1, 2 or 3 phase. In some instances, where extra wide range of speed or severe accelerating or reversing duty is required, it might even be advisable to recommend direct current and install conversion equipment.

Essentials to Guide Your Planning

A. PLANS

In these larger buildings, it is essential that a complete set of plans be available before starting the wiring layout. The structural design of the building, the location of walls and partitions have a direct bearing on the layout, so the plans should include all this information.

While it might be possible to indicate all the electrical wiring on the original plans, it is better to make separate wiring plans except in very small installations. Show the location of all outlets, switches, motors, controllers, auxiliary equipment, panelboards, service equipment and also special systems such as telephone and signaling systems. A riser diagram, showing the number and size of the feeders also should be attached to the wiring layout.

B. LAYOUT PROCEDURE

In order to make the layout of the wiring job simple and insure that all possibilities are covered, approach the job in an orderly manner. In general it will be advisable to consider the following five steps—at the outset—

1. *Service*

Determine the type and location of the service. Secure this information from the local utility company. Then, after the approximate demand for the building has been decided upon, provide space for the service raceway, service equipment, transformer station and main distribution center. The exact type and capacity of this equipment can be decided later, after the load has been calculated.

2. *Lighting Layout*

Locate all lighting outlets, switches, convenience outlets or special purpose outlets and mark them on the plans. Locate the lighting panelboards, determine and number the circuits, interconnect the outlets on one circuit, and show the home runs to the individual panels. Also show

UNDER-FLOOR LAYOUTS *and specifications should eliminate all possibility of mistakes and omissions that are difficult and expensive to correct later—sometimes impossible.*

number and size of wires, where larger than No. 12, and indicate the size and type of raceway or cable assembly.

3. *Power Layout*

Locate all motors, controllers, stationary heating devices, and special control devices and mark them on the plans. Locate the power panelboards and where combined power and lighting panelboards are used, provide a correct and economical location. Determine what equipment should be interconnected on one circuit. In all other respects follow the same routine as for lighting.

4. *Auxiliary System Layout*

Determine what type of auxiliary systems should be installed. Then locate on the plans the outlets for each system and the accessory equipment required, such as terminal cabinets, transformers or batteries. Indicate on the plans the subdivision and circuit routing and provide circuits for the auxiliary systems on the lighting panelboards.

Frequently it will be advisable to prepare schematic diagrams including the outlet location and power supply for the more complicated auxiliary systems. Attach them to the wiring plans.

5. *Feeders*

After the outlets and devices for the entire installation are located and the total load is ascertained, route and indicate the feeders on the plans. In any installation having more than one or two feeders, it is also necessary to draw up a riser diagram. Show the complete feeder system, service and main distribution equipment.

C. CONDITIONS TO BE CONSIDERED

On any job special conditions may be encountered which influence the wiring layout and the selection of equipment. Search out all such conditions before writing the specifications. Particular consideration should be given to the following four problems—

1. *Structural Features*

When making the layout, study the structural design of the building. It will frequently affect the location of the panelboards, the length of the feeders, and in all cases, of course, the choice of materials. When making the wiring plans for concealed work in fireproof construction, show the circuit runs, as far as possible in a straight line from outlet to outlet. Use right angle bends for concealed work in wood joist construction. Show these bends on the wiring plans. Indicate the approximate actual position of the runs for exposed work.

2. *Protection Against Abuse*

When conditions are found which might interfere with the successful operation of the equipment, isolate or protect the system wherever such hazardous locations exist. In article 500, the Code specifies the type of wiring and the wiring materials to be used in hazardous locations. But aside from the hazardous locations mentioned in the Code, there are a great number of abuses which may affect the electrical equipment and must be guarded against, such as—

a. Abrasive metals, dust, and chips
b. Condensation
c. Corrosive atmospheres
d. Excessive temperatures
e. Grease and oil
f. Excessive vibration
g. Water drippage or splashing
h. Explosive dust or fumes
i. Ignitable fibres, flyings or accumulations
j. Flood waters

The planning of explosion-proof wiring is a broad subject in itself, beyond the scope of this discussion. But hazardous locations are becoming more common in industry, and must be handled with knowledge and judgment.

3. *Providing for Future Additions*

Under modern conditions, with the use of electricity steadily increasing, it is necessary to plan for future additions to the system. An installation which takes care of the present load only, will surely be overloaded within a very few years.

The simplest way to take care of future needs, of course, is to assume in the beginning a total connected load higher than the actual requirement and wire accordingly. But the problem is not so simple because of economic factors. A wiring system that costs too much for the service it performs at present is obviously under attack. Therefore provisions for future additions should be planned an economical way, through such features as—

a. Provide surplus capacity in service and main panel.

b. If a feeder distribution panel is used, provide capacity for one or two additional feeders.

c. Install feeder raceways large enough to permit the drawing in of additional or larger feeders, at a later date.

d. Subdivide the load into a sufficiently larger number of panels, so that different parts of the building become electrically independent of each other. This permits the changing of one panel without affecting the efficiency of other parts of the building. It also makes the additions to the feeders or their replacement less costly.

e. In cases where very large feeder cables are used initially, install spare conduits. Replacing large feeders is expensive.

f. Provide a reasonable number of spare circuits on each panel.

g. Calculate wire sizes for feeders and branch circuits so as to leave sufficient capacity for added load. An extra capacity of at least 20 per cent to 50 per cent should be considered.

h. Keep the number of outlets and the load per circuit as low as reasonably possible. For lighting circuits 1000 watts is recommended. For convenience outlet circuits use only six or even less outlets per circuit.

D. SELECTING THE MOST ECONOMICAL SYSTEM

To lay out a system which is economical, due weight must be given to the various factors which may reduce the cost of operating that system and also of altering it to better serve the growing or changing needs of the building. Among these factors are—

1. *Safety and Reliability*

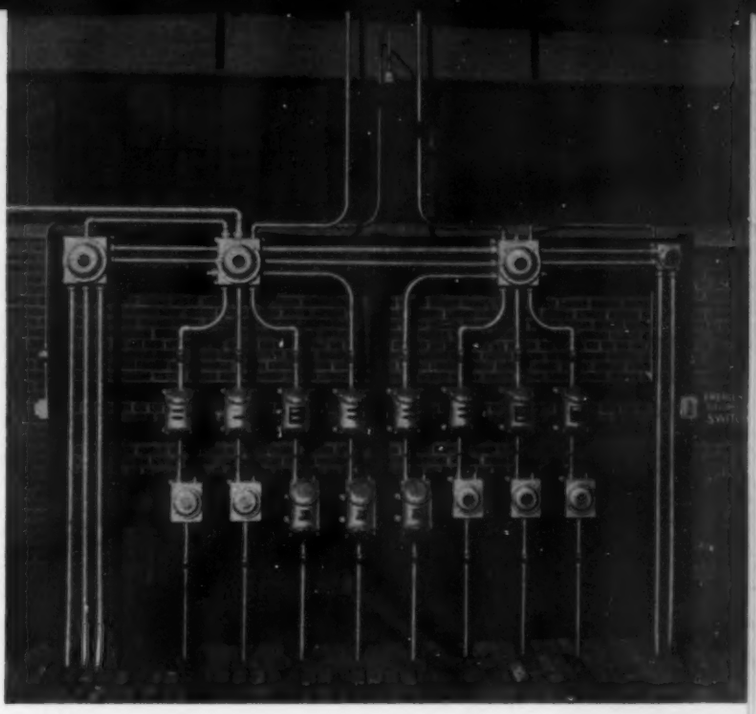
This can be assured by the proper selection of materials, and equipment, proper size wires and cables, and good workmanship.

2. *Flexibility*

The use of proper materials applies here also. Busways and wireways often assure a large degree of flexibility, since busways can be arranged to accommodate plug-in devices and facilitate their change from one location to another. Wireways give simple means of carrying larger feeders and motor branch circuits. The use of an underfloor duct system, particularly in office buildings, makes the layout flexible enough for any reasonable purpose. In industrial plants, the use of an underfloor duct system provides outlets suitably spaced for the connection of small motors.

3. *Copper and Voltage Losses*

For lighting circuits the total voltage drop should not exceed 1.5 per cent. For motor circuits the total drop from the service entrance to the motor should not be more than 5 per cent. For a.c. motors voltage drop calculations should include the reactance of the circuit as well as the resistance. If the power factor is not definitely known, it should be assumed at 80 per cent.



HAZARDOUS AREAS *cannot risk vague or improperly specified types of explosion proof wiring. This oil refinery installation reveals good planning.*

4. *System and Service*

The choice of the system depends largely on the size of the equipment to be used. The choice of single, two or three phase systems is influenced by the size of the motor to be installed; so is the voltage. Standard 115-230 volt motors have a definite horsepower limit. Where very large motors are used it might occasionally be advisable to recommend a potential as high as 2200 or 6600 volts.

If the project is extensive enough, it might become economical to buy primary power and transform it to the desired voltage. By this means large reduction in the power bill might be accomplished.

No firm and definite rules can be given here for the selection of the proper system for individual jobs. Conditions and power applications vary. Each case must be considered and solved by itself. Recommend the system which will be most suitable.

What to Do for Lighting

A. STANDARDS TO APPLY

Laying out wiring for lighting in larger buildings often becomes a difficult problem. The amount of illumination, while probably the most important consideration, is by no means the only feature to be decided upon. Distribution, quality of light, color, shadow, glare and contrast also should have attention.

Lighting fixtures are usually classified by the relation of the unit to the working space. A luminare may be designed so that all the light output is directed towards the working space or the light may be directed towards the ceiling, which is used as a secondary reflector. Or the fixture may be designed so that it combines both of these conditions. And the uniformity of the illumination and the appearance of the installation will be definitely influenced by the mounting height of the lighting units.

In general, direct type lighting fixtures are mounted with reference to the distance from the working surface. Most types are so designed that a mounting height equal to the spacing between fixtures will be about the minimum for uniform distribution of light. On the other hand, install indirect lighting fixtures in relation to the ceiling. Manufacturers of these fixtures, for this reason, supply a stand-

TRANSFORMER STATIONS *for larger layouts must have all the advantages of quality, workmanship and planning that can be combined to insure safe and adequate capacity for heavy loads.*

ard length of hangers based on wattage and light distribution. In general, uniform illumination will result if the spacing of these units is about equal to the ceiling height.

But selection of fixtures and spacing of the units does not complete the job. The current supply to the fixtures, with its feeders, sub-feeders, and branch-circuits, the control equipment in the panels, and the switching of the equipment play an important part in the design of any wiring installation. The best of light fixtures will not work with full efficiency, if the voltage drop becomes too high. The best layout becomes cumbersome, if care is not taken to make the control of the light source flexible.

B. LAYING OUT THE SYSTEM

1. *Location of Outlets*

When locating outlets, study the structural design of the building. Ceiling beams and special architectural features found in theatres, churches and large auditoriums, for example, may seriously affect the lighting layout. For buildings of this type no general recommendations can be given. Each individual case has its own peculiar requirements.

a—Ceiling outlets for general illumination

Space ceiling outlets uniformly with equal spacing in both directions. The spacing between adjacent outlets should not be more than 1¼ times the distance between floor and ceiling, except in school and office buildings, where the spacing should be equal to the distance between floor and ceiling. In halls and corridors, lighted from a single row of ceiling outlets, the spacing between outlets should not be more than 20 feet.

b—Outlets for Stores

1. *Convenience outlets—general*

At least one outlet should be provided for each 400 square feet of floor area. It is good practice to install one outlet in each supporting column for connecting decorative lighting fixtures and other electrical equipment. Install the outlets whenever possible in side walls. No part of the floor should be more than 15 feet from any outlet.

2. *Convenience outlets in show windows*

Each window should have at least two convenience outlets. If the window is larger than 100 square feet, there should be at least one convenience outlet for each 50 square feet. The convenience outlets should be installed in or near the floor.

3. *Outlets for show window illumination*

Each window should be equipped with at least two outlets symmetrically spaced for spot or flood lights. If the window has more than 16 linear feet of glass, one outlet should be added for each 8 feet or major fraction thereof. In addition to these outlets, provide junction boxes at suitable height on walls or columns to connect show window lighting circuits. Space show window reflectors, 12 to 18 inches apart, if medium screw lampholders are used. The spacing can be 15-24 inches apart where mogul lampholders are employed.

4. *Outlets for show case and wall case lighting*

Install outlets in the floor or wall for connecting lighting equipment. Allow sufficient capacity to carry show case circuits. (For standard loads see table page 52.)

5. *Outlets for signs*

If no signs are contemplated when the building is wired, a raceway not smaller than 1 inch should be run to the front of the building for each probable individual store. Terminate this raceway on the outside of the building at a suitable point for the installation of the sign and on the inside of the building at a cabinet. Assume for feeder capacity a load of 50 watts per linear foot of store frontage. Only the frontage on the principal street need be considered.

6. *Office convenience outlets*

Provide at least one convenience outlet for each 20 feet of linear wall space or major fraction thereof, for offices of 400 square feet or less of floor area. Equip offices of more than 400 square feet with at least four convenience outlets for the first 400 square feet of floor area and not less than two additional outlets for each additional 400

square feet of floor area or major fraction thereof. Locate the outlets so as to serve all parts of the office. Offices which require a larger number of outlets due to their occupancy should be studied individually.

7. Factory outlet location

The data given in the table on page 52 gives minimum standards for obtaining uniform general illumination. Where special work processes need higher intensities of lighting, the table must be supplemented by additional local or general lighting to provide for these special needs. Since it is impossible to tabulate all the locations where extra high intensities of light are used, this table can only be considered as a standard for average conditions. At least one convenience outlet shall be installed in each bay in both manufacturing and storage spaces.

2. *Circuiting and Control*

The tables on pages 52, 53, 54 and 55 provide recommended standards of illumination, spacing of lighting outlets, classification of interiors and illumination values, calculated for various lamp sizes and equipment types. Use them in calculating the wattage required for good lighting. In turn this wattage should be used for the calculation of the service, feeders and the number of branch circuits. Where a load is contemplated larger than the one computed from these tables, this larger load should be the basis of these calculations.

The data used in these tables are based on the normal types of incandescent lamps. Where high efficiency lamps —such as mercury vapor lamps—are used, it may be possible to reduce the computed wattage. However, in these cases power factor and starting requirements must be taken into consideration.

a—Branch circuits

Not more than 1000 watts should be connected to a 2-wire 15 amp. branch-circuit. Or if multiwire branch-circuits are used, the load should not exceed 1000 watts between each outside wire and the neutral. Good practice limits the load in heavy duty lamp circuits to 1500 watts for No. 10 conductor, 2500 watts for No. 8 conductor, and 3000 watts for No. 6 conductor.

b—Convenience outlet branch-circuit

Do not install convenience outlets on the same circuits with outlets for general illumination. All convenience outlets primarily intended for supplementary lighting loads should be duplex outlets. All convenience outlets for appliances or power devices should be of the polarity type. Wire convenience outlets for show window spot and flood-lighting to a separate circuit.

c—Number of circuits

This table shows the maximum number of convenience outlets on one circuit for various occupancies. Provide at least one branch circuit for every 1200 square feet or major fraction thereof of manufacturing space. In storage spaces, provide at least one branch circuit for each 2400 square feet of floor area or major fraction thereof. In office spaces, provide at least one branch circuit to supply convenience outlets for each 800 square feet of floor area or major fraction thereof.

Where the load to be connected to the convenience outlets is definitely known, this specific load should form the basis for calculating the branch circuit. Do not exceed the space limits given above.

Circuit Loading in Commercial Buildings

Location of Convenience Outlets	Max. Number of Outlets Per Circuit
Display areas in retail stores	6
Store show windows, for spot or flood lights	3
Store show windows, in or near floor	6
Barber shops and beauty parlors	2
Physicians' offices and dentists' offices	2
All other locations, except office spaces, manufacturing spaces and storage spaces	10

d—Circuit wire sizes

Branch-circuit wiring should be not less than No. 12 awg. For runs of over 50 feet from the panelboard to the first outlet, the size of wire should be at least one size larger for that portion of the circuit. Between the outlets the calculated wire size can be used.

Avoid runs of over 100 feet from the panelboard to the first outlet except where the connected load is so small that the voltage drop can be limited to 2 per cent between the panelboard and the last outlet on the circuit. If runs of 100 feet or over should occur, relocate the panelboards or install additional panelboards near the center of the load.

e—Circuit control

Suitable control should be installed in all circuits. Circuits supplying only convenience outlets may not require this control, but it is frequently advisable.

Panelboards equipped with circuit switches or circuit breakers are suitable for controlling the circuits in stores. In most other occupancies, provide one or more local switches or circuit breakers for the control of the outlets.

Sign or outline lighting should be controlled by a single externally operatable switch or circuit breaker. A suitable

SWITCHBOARD CONSTRUCTION *is based on adequate system layout. With this well done, the various design details can be specified to fully provide for long-time use.*

STANDARDS OF ILLUMINATION FOR INDUSTRIAL INTERIORS

Recommended by Nela Park Laboratories

(These foot-candle values represent order of magnitude rather than exact levels of illumination)

	Foot-Candles
Aisles, Stairways, Passageways	2
Assembly:	
Rough	10
Medium	20
Fine	B*
Extra Fine	A*
Automobile Manufacturing:	
Assembly Line	B*
Frame Assembly	15
Body Manufacturing—	
Parts	20
Assembly	20
Finishing and Inspecting	A*
Bakeries	20
Book Binding:	
Folding, Assembling, Pasting, etc.	10
Cutting, Punching and Stitching	20
Embossing	20
Breweries:	
Brew House	5
Boiling, Keg Washing and Filling	10
Bottling	15
Candy Making	20
Canning and Preserving	20
Chemical Works:	
Hand Furnaces, Boiling Tanks, Stationary Driers, Stationary and Gravity Crystallizers	5
Mechanical Furnaces, Generators and Stills, Mechanical Driers, Evaporators, Filtration, Mechanical Crystallizers, Bleaching	10
Tanks for Cooking, Extractors, Percolators, Nitrators, Electrolytic Cells	15
Clay Products and Cements:	
Grinding, Filter Presses, Kiln Rooms	5
Molding, Pressing, Cleaning and Trimming	10
Enameling	15
Color and Glazing	20
Cleaning and Pressing Industry:	
Checking and Sorting	20
Dry and Wet Cleaning and Steaming	10
Inspection and Spotting	A*
Pressing—	
Machine	20
Hand	C*
Receiving and Shipping	10
Repair and Alteration	C*
Cloth Products:	
Cutting, Inspecting, Sewing—	
Light Goods	20
Dark Goods	A*
Pressing, Cloth Treating (Oil Cloth, etc.)—	
Light Goods	10
Dark Goods	20
Coal Tipples and Cleaning Plants:	
Breaking, Screening and Cleaning	10
Picking	A*
Dairy Products	20
Elevators—Freight and Passenger	10
Engraving	A*
Forge Shops and Welding	10
Foundries:	
Charging Floor, Tumbling, Cleaning, Pouring and Shaking Out	5
Rough Molding and Core Making	10
Fine Molding and Core Making	20
Garages—Automobile:	
Storage—Live	5
Dead	2
Repair Department and Washing	C*

	Foot-Candles
Glass Works:	
Mix and Furnace Rooms, Pressing and Lehr, Glass Blowing Machines	10
Grinding, Cutting Glass to Size, Silvering	20
Fine Grinding, Polishing, Beveling, Etching and Decorating	C*
Inspection	B*
Hangers—Aeroplane:	
Storage—Live	10
Repair Department	C*
Ice Making—Engine & Compressor Room	10
Inspection:	
Rough	10
Medium	20
Fine	B*
Extra Fine	A*
Jewelry and Watch Manufacturing	A*
Laundries	20
Leather Manufacturing:	
Vats	5
Cleaning, Tanning and Stretching	10
Cutting, Fleshing and Stuffing	15
Finishing and Scarfing	20
Leather Working:	
Pressing, Winding and Glazing—	
Light	10
Dark	20
Grading, Matching, Cutting, Scarfing, Sewing—	
Light	20
Dark	A*
Locker Rooms	5
Machine Shops:	
Rough Bench and Machine Work	10
Medium Bench and Machine Work, Ordinary Automatic Machines, Rough Grinding, Medium Buffing and Polishing	20
Fine Bench and Machine Work, Fine Automatic Machines, Medium Grinding, Fine Buffing and Polishing	B*
Extra Fine Bench and Machine Work, Grinding—Fine Work	A*
Meat Packing:	
Slaughtering	10
Cleaning, Cutting, Cooking, Grinding, Canning, Packing	20
Milling—Grain Foods:	
Cleaning, Grinding and Rolling	10
Baking or Roasting	20
Flour Grading	30
Offices	See Page 53
Packing and Boxing	10
Paint Mixing	10
Paint Shops:	
Dipping, Spraying, Firing, Rubbing, Ordinary Hand Painting and Finishing	20
Fine Hand Painting and Finishing	B*
Extra Fine Hand Painting and Finishing (Automobile Bodies, Piano Cases, etc.)	A*
Paper Box Manufacturing:	
Light	10
Dark	20
Storage	5
Paper Manufacturing:	
Beaters, Grinding, Calendering	10
Finishing, Cutting, Trimming	20
Plating	10
Polishing and Burnishing	15

	Foot-Candles
Printing Industries:	
Type Foundries—	
Matrix Making, Dressing Type	A*
Font Assembly—Sorting	B*
Hand Casting	C*
Machine Casting	20
Electrotyping—	
Molding, Finishing, Leveling Molds, Routing, Trimming	B*
Blocking, Tinning	C*
Electroplating, Washing, Backing	20
Photo Engraving—	
Etching, Staging	20
Blocking	C*
Routing, Finishing, Proofing	B*
Tint Laying	A*
Receiving and Shipping	10
Rubber Manufacturing and Products:	
Calendars, Compounding Mills, Fabric Preparation, Stock Cutting, Tubing Machines, Solid Tire Operations, Mechanical Goods, Building Vulcanizing	10
Bead Building, Pneumatic Tire Building and Finishing, Inner Tube Operation, Mechanical Goods Trimming, Treading	20
Sheet Metal Works:	
Miscellaneous Machines, Ordinary Bench Work	15
Punches, Presses, Shears, Stamps, Welders, Spinning, Medium Bench Work	20
Tin Plate Inspection	C*
Shoe Manufacturing:	
Cutting and Stitching—	
Cutting Tables	10
Marking, Buttonholing, Skiving, Sorting, Vamping, and Counting—	
Light materials	20
Dark materials	C*
Stitching—	
Light materials	C*
Dark materials	B*
Marking and Finishing—	
Stitchers, Nailers, Sole Layers, Welt Beaters and Scarfers, Trimmers, Welters, Lasters, Edge Setters, Sluggers, Sanders, Wheelers, Treers, Cleaning, Spraying, Buffing, Polishing, Embossing—	
Light materials	20
Dark materials	C*
Silk and Rayon Manufacturing:	
Soaking, Fugitive Tinting, and Conditioning or Setting of Twist	10
Winding, Twisting, Rewinding, and Coning, Quilling, Slashing	30
Warping (Silk or Cotton System)—	
On Creel, on Running Ends, on Reel, on Beam, on Warp at Beaming	C*
Drawing-In—	
On Heddles	A*
On Reed	A*
Weaving—	
On Heddles and Reeds	5
On Warp Back of Harness	10
On Woven Cloth	30
Steel and Iron Manufacturing:	
Billet, Blooming, Sheet Bar, Skelp and Slabbing Mills	5

	Foot-Candles
Boiler Room, Power House, Foundry and Furnace Rooms	5
Hot Sheet and Hot Strip Mills	10**
Cold Strip, Pipe, Rail, Rod, Tube, Universal Plate and Wire Drawing	10**
Merchant and Sheared Plate Mills	15**
Tin Plate Mills—	
Hot Strip Rolling and Tinning Machine Dept.	10
Cold Strip Rolling	15
Inspection—	
Black Plate	C*
Bloom and Billet Chipping	C*
Tin Plate and Other Bright Surfaces	B*
Repair Shops—	
Rough Bench and Machine Work	10
Medium Bench and Machine Work	B*
Fine Work—Buffing, Polishing, etc.	B*
Extra Fine Work	A*
Blacksmith Shop	10
Laboratories (Chemical and Physical)	15
Carpenter and Pattern Shop	20
Storage	2
Stone Crushing and Screening:	
Belt Conveyor Tubes, Main Line Shafting Spaces, Chute Rooms, Inside of Bins	5
Primary Breaker Room, Auxiliary Breakers under Bins	5
Screens	10
Store and Stock Rooms:	
Rough Bulky Material	2
Medium or Fine Material Requiring Care	10
Structural Steel Fabrication	10
Textile Mills (Cotton):	
Opening, Mixing, Picking, Carding and Drawing	5
Slubbing, Roving, Spinning	15
Spooling, Warping on Comb	20
Beaming, and Slashing on Comb—	
Grey Goods	20
Denims	B*
Inspection—	
Grey Goods (Hand Turning)	C*
Denims (Rapidly Moving)	A*
Automatic Tying-In, Weaving	B*
Drawing-In By Hand	A*
Tobacco Products:	
Drying, Stripping, General	10
Grading and Sorting	A*
Toilets and Wash Rooms	5
Upholstering—Automobile, Couch, Furniture	20
Warehouse	5
Woodworking:	
Rough Sawing and Bench Work	10
Sizing, Planing, Rough Sanding, Medium Machine and Bench Work, Gluing, Veneering, Cooperage	20
Fine Bench and Machine Work, Fine Sanding & Finishing	C*
Woolen:	
Carding, Picking, Washing, Combing	10
Twisting, Dyeing	10
Drawing-In, Warping—	
Light Goods	15
Dark Goods	30
Weaving—	
Light Goods	15
Dark Goods	30
Knitting Machines	20

(*) (**) See opposite Page for footnotes.

STANDARDS OF ILLUMINATION FOR STORES, COMMERCIAL AND PUBLIC INTERIORS

Recommended by Nela Park Laboratories

(These foot-candle values represent order of magnitude rather than exact levels of illumination)

	Foot-Candles
Armories — Drill Sheds and Exhibition Halls	10
Art Galleries:	
General	5
On Paintings	B*
Auditoriums	5
Automobile Show Rooms	20
Banks:	
Lobby	15
Cages	B*
Offices	20
Barber Shops and Beauty Parlors	20
Churches:	
Auditoriums	5
Sunday School Rooms	10
Pulpit or Rostrum	20
Club and Lodge Rooms:	
Lounge and Reading Rooms	20
Auditoriums	5
Court Rooms	10
Dance Halls	5
Depots:	
Waiting Rooms	10
Ticket Offices—	
General	10
Ticket Rack and Counters	B*
Rest Rooms, Smoking Rooms	10
Baggage Checking Office	10
Storage	5
Concourse	5
Platforms	2
Drafting Rooms:	
Prolonged Close Work, Art in Detail	C*
Drafting and Designing Rough Drawing and Sketching	30
Fire Engine Houses:	
When alarm is turned in	10
At other times	2
Garages—Automobile:	
Storage—Dead	2
Live	5
Repair and Washing Departments	C*
Hangars—Aeroplane:	
Storage—Live	10
Repair Department	C*

	Foot-Candles
Hospitals:	
Corridors	2
Laboratories	20
Lobby & Reception Room	5
Operating Room General	20
Operating Table Major Operations	1000
Minor Operations	200
Private Rooms (with local illumination)	20
Wards (with local illumination)	20
Hotels:	
Lobby	10
Dining Room	5
Kitchen	20
Guest Rooms	10
Corridors	2
Writing Rooms	20
Library:	
Reading Room	20
Stack Room	10
Moving Picture Theatre:	
During Intermission	5
During Pictures	0.1
Museums:	
General	10
Special Displays	B*
Night Clubs and Bars	5
Office Buildings:	
Bookkeeping, Typing and Accounting	30
Business Machines—Power Driven (Transcribing & Tabulating)—	
Calculators, Key Punch, Bookkeeping	B*
Conference Room—	
General Meetings	10
Office Activities — See Desk Work	
Corridors and Stairways	5
Desk Work—	
Intermittent Reading and Writing	20
Prolonged Close Work, Computing, Studying, Designing, etc.	C*
Reading Blueprints and Plans	30

	Foot-Candles
Office Buildings, (continued)	
Drafting—	
Prolonged Close Work—	
Art Drafting and Designing in Detail	C*
Rough Drawing and Sketching	30
Filing and Index References	20
Lobby	10
Mail Sorting	20
Reception Rooms	10
Stenographic Work—	
Prolonged Reading Shorthand Notes	C*
Vault	10
Post Office:	
Lobby	10
Sorting, Mailing, etc.	20
Storage	10
Offices—Private & General	20
File Room and Vault	10
Corridors and Stairways	2
Professional Offices:	
Waiting Rooms	10
Consultation Rooms	20
General Offices	20
Dental Chairs and Doctors' Examination Rooms	A*
Restaurants, Lunch Rooms and Cafeterias:	
Dining Areas	10
Food Displays	C*
Schools:	
Auditoriums and Lecture Rooms—	
General	10
Special Exhibits	C*
Class and Study Rooms—	
Desks & Blackboards	20
Corridors and Stairways	5
Drawing Room	C*
Gymnasium	20
Laboratories:—	
General	15
Close Work	C*
Library and Offices	20
Manual Training—	
General	20
Close Work	B*
Sewing Room	B*
Sight-Saving Classes	C*
Service Space:	
Corridors	5

	Foot-Candles
Service Space, continued:	
Elevators—Freight and Passenger	10
Halls and Stairways	5
Storage	5
Toilets and Wash Rooms	5
Show Cases	B*
Show Windows:	
Large Cities—	
Brightly Lighted Districts	200
Secondary Business Locations	100
Neighborhood Stores	50
Medium Cities—	
Brightly Lighted District	100
Neighborhood Stores	50
Small Cities and Towns	50
Lighting to Reduce Daylight Window Reflections	200–1000
Special Displays Inside Store:	
Light Colored	C*
Medium Colored	B*
Dark Colored	A*
Stores:	
Large Cities—	
Brightly Lighted Districts	20
Secondary Business Locations	20
Neighborhood Stores	15
Medium Cities—	
Brightly Lighted Districts	20
Neighborhood Stores	15
Small Cities and Towns	15
Telephone Exchanges:	
Operating Rooms	5
Terminal Rooms	15
Cable Vaults	5
Theatres:	
Auditoriums	5
Foyer	10
Lobby	15
Transportation:	
Cars—	
Baggage, Day Coach, Dining, Pullman	15
Mail—	
Bag Racks and Letter Cases	20
Storage	5
Street Railway, Trolley Bus and Subway	15
Motor Bus	10

**In these areas many of the machines require one or more supplementary lighting units mounted on them in order to effectively direct light toward the working points.

*Lighting recommendations for the more difficult seeing tasks, as indicated by A, B, and C in the foregoing table, are as follows:

GROUP A — These seeing tasks involve (a) the discrimination of extremely fine detail under conditions of (b) extremely poor contrast, (c) for long periods of time. To meet these requirements, illumination levels above 100 foot-candles are recommended.

To provide illumination of this order a combination of at least 20 foot-candles of general lighting plus specialized supplementary lighting is necessary. The design and installation of the combination systems must not only provide a sufficient amount of light but also must provide the proper direction of light, diffusion, eye protection and, insofar as possible, must eliminate direct and reflected glare as well as objectionable shadows.

GROUP B — This group of visual tasks involves (a) the discrimination of fine detail under conditions of (b) a fair degree of contrast (c) for long periods of time. Illumination levels from 50 to 100 foot-candles are required.

To provide illumination of this order a combination of 10 to 20 foot-candles of general lighting plus specialized supplementary lighting is necessary. The design and installation of the combination systems must not only provide a sufficient amount of light but also must provide the proper direction of light, diffusion, eye protection and, insofar as possible, must eliminate direct and reflected glare as well as objectionable shadows.

GROUP C — The seeing tasks in this group involve (a) the discrimination of moderately fine detail under conditions of (b) better than average contrast (c) for intermittent periods of time. The level of illumination required is of the order of 30 to 50 foot-candles and in some instances it may be provided from a general lighting system. Oftentimes, however, it will be found more economical and yet equally satisfactory to provide from 10 to 20 foot-candles from the general system and the remainder from specialized supplementary lighting. The design and installation of the combination systems must not only provide a sufficient amount of light but also must provide the proper direction of light, diffusion, eye protection and, insofar as possible, must eliminate direct and reflected glare as well as objectionable shadows.

Standards For Indoor Recreational Lighting

	Foot-Candles
Billiards:	
General	10
On Tables	50
Bowling:	
General	10
On Pins	50
Boxing:	
Seats	2

	Foot-Candles
Boxing, continued:	
Ring: Amateur	100
Professional	200
Championship	500
Gymnasium:	
Exercising Room	15
Shower Rooms	10
Locker Rooms	5

	Foot-Candles
Gymnasium, continued:	
Fencing, Boxing, Wrestling, Basket Ball	20
Soft Ball	30
Skating Rink	10
Table Tennis—Ping Pong	30
Tennis: Recreational	20
Tournament	30

	Foot-Candles
Other Sports:	
Badminton, Handball, Racquet, Squash	30
Basket Ball, Volley Ball	20

METHOD OF SOLVING LIGHTING PROBLEMS

STEP 1 — Spacing Layout

Sketch the Floor Plan of the room to be lighted and arrange outlet spacing symmetrically with respect to bays, columns, or other architectural features. Table A gives the usual spacing as well as the maximum allowable spacing for various ceiling heights, assuming the units are mounted as high as possible.

Determine actual *area per outlet* and apply in Table C.

Example: School classroom, size 32′ x 22′, ceiling height 12′; white ceiling (light), buff walls (medium). Indirect. Recommended — 20 foot candles. (References marked † in accompanying tables.)

From Table A
Maximum spacing allowable.....12 ft.
Actual spacing used.....10⅔ x 11 ft.
Area per outlet .....117 square feet

From Table B
Conditions Factor=A

From Table C
Under Type E — opposite 110-125 square feet — Conditions A show a 500-watt lamp will produce the required foot candles. Properly wired, 1000-watt lamps may be used in the future.

TABLE A—Spacing of Lighting Outlets

Ceiling Height (Or Height in the Clear)	Spacing Between Outlets		Spacing Between Outside Outlets and Wall		Approx. Area per Outlet (At Usual Spacings)
	Usual	Maximum (For Units at Ceiling)	Aisles or Storage Next to Wall	Desks, Workbenches, etc. Against Wall	
(Feet)	(Feet)	Not more than*	Usually	Not more than*	(Sq. Ft.)
8	7	7½	one-	3	50–60
9	8	8		3	60–70
10	9	9	half	3½	70–85
11	10	10½		3½	85–100
12 †	10–12 †	12 †	actual	3½–4	100–150
13	10–12	13	spacing	3½–4½	100–150
14	10–13	15		4–5	100–170
15	10–13	17	between	4–5	100–170
16	10–13	19		4–6	100–170
18	10–20	21	units	4–6	100–400
20	18–24	24		5–7	300–500
20 and up	20–30	30		5–7	400–900

*Where it is definitely known that some form of indirect lighting will be used, the maximum spacing between outlets may be increased about two feet, and the distance from the outside outlets to the wall may be increased by one foot.
Note: Column 2 in Table C. gives the minimum mounting height for direct lighting units (Types A, B and C) for the actual spacing used. Suspension distance of indirect units (Types D and E) largely a matter of appearance.

TABLE B—Classification of Interiors

Approximate Proportions of Room	Color Ceiling and Upper Sidewalls	CONDITIONS FACTOR			
		Direct-Lighting Types A, B and C		Indirect-Lighting Types D and E	
		Maintenance		Maintenance	
		Very Good	Fair	Very Good	Fair
Width 4 times ceiling height	Light	A	A	A	A
	Medium	A	A	A	B
	Dark	A	B	C	C
Width 2 times ceiling height	Light	A	B	A†	B
	Medium	A	B	B	C
	Dark	B	C	C	*
Width equal to ceiling height	Light	B	C	B	C
	Medium	C	C	C	*
	Dark	C	C	C	*

STEP 2 — Interior Conditions

Classify the room and maintenance conditions into one of the three classes in Table B. This takes into account the proportions of the room, interior finish, and maintenance conditions, each of which bears an important relation to lighting results.
Apply this " conditions factor " in turn in Table C.

TABLE C—Classification of Interior Conditions

On table below read area per outlet according to known conditions, then follow line across to opposite page under type of fixture and to foot candles required. This will give the wattage necessary in each fixture to produce the desired illumination.

Area Per Outlet Adequately Lighted or Approximate Spacing	Distance from Underside of Reflector to Floor to be Not Less Than	Conditions Factor
55-65 Sq. Ft. or 7¾′x7¾′ Spacing	7′ 6″	A B C
65-75 Sq. Ft. or 8½′x8½′ Spacing	8′ 6″	A B C
75-85 Sq. Ft. or 9′x9′ Spacing	8′ 6″	A B C
85-95 Sq. Ft. or 9½′x9½′ Spacing	9′ 0″	A B C
95-110 Sq. Ft. or 10′x10′ Spacing	9′ 6″	A B C
110-125 Sq. Ft. † or 11′x11′ Spacing	10′ 0″	A † B C
125-145 Sq. Ft. or 11½′x11½′ Spacing	10′ 6″	A B C
145-170 Sq. Ft. or 12½′x12½′ Spacing	11′ 6″	A B C
170-200 Sq. Ft. or 13½′x13½′ Spacing	11′ 6″	A B C
200-230 Sq. Ft. or 14¾′x14¾′ Spacing	12′ 6″	A B C
230-260 Sq. Ft. or 15½′x15½′ Spacing	13′ 0″ (High Bay 15′)	A B C
260-300 Sq. Ft. or 16¾′x16¾′ Spacing	13′ 6″ (High Bay 16′)	A B C
300-340 Sq. Ft. or 18′x18′ Spacing	14′ 6″ (High Bay 17′)	A B C
340-390 Sq. Ft. or 19′x19′ Spacing	15′ 6″ (High Bay 17′)	A B C
380-440 Sq. Ft. or 20′x20′ Spacing	17′	A B C
440-530 Sq. Ft. or 22′x22′ Spacing	18′	A B C
530-625 Sq. Ft. or 24′x24′ Spacing	22′	A B C
625-730 Sq. Ft. or 26′x26′ Spacing	25′	A B C
730-940 Sq. Ft. or 28′x28′ Spacing	27′	A B C
940-1050 Sq. Ft. or 30′x30′ Spacing	30′	A B C

Mount Units 12′ High Wherever Possible

—Recommended by NELA PARK LABORATORIES

STEP 3 — Foot Candles Produced — Equipment Types, Lamp Sizes

When the lighting layout has been made, the type of equipment selected, and the conditions established in accordance with previous discussion, refer to Table D to obtain the foot candles produced by the various sizes of lamps under the conditions of use. Choose the lamp size necessary to produce the foot-candle standard recommended for the particular application at hand. For recommended foot-candle standards, refer to pages 52 and 53.

TABLE D—Illumination Values Calculated for Various Lamp Sizes in Various Equipment Types

TYPE A Direct Lighting Equipment for Low Mounting Such as Glassteel and RLM Type Fixtures Industrial Average Foot Candles					TYPE B Direct Lighting High Bay Fixtures Industrial Average Foot Candles					TYPE C Semi-Direct Lighting Commercial Average FootCandles			TYPE D Semi-Indirect Lighting Commercial Average Foot Candles			TYPE E Indirect Lighting Commercial Average Foot Candles			
200 Watt	300 Watt	500 Watt	750 Watt	400 Watt Merc.	500 Watt	750 Watt	1000 Watt	1500 Watt	400 Watt Merc.	200 Watt	300 Watt	500 Watt	300 Watt	500 Watt	750 Watt	300 Watt	500 Watt	750 Watt	1000 Wat
18-23										15-22			22-30			15-24	27-40		
14-18										11-15			14-22			9-15	16-27		
11-14										7-9			10-14			7-9	13-16		
15-19	24-32									13-19	21-31		19-25	32-41		13-20	23-33		
11-15	17-24									9-13	15-21		12-19	20-32		8-13	14-23		
9-11	14-17									6-8	11-15		8-12	14-20		6-8	11-14		
13-17	21-28									11-17	18-28		16-22	27-37		11-18	19-31	29-46	
10-13	17-21									8-11	13-18		10-16	18-27		7-11	13-19	19-29	
8-10	13-17									6-7	10-12		7-10	13-18		5-7	9-13	13-19	
12-15	21-25	35-41								10-14	17-24	27-40	14-19	24-32		10-14	17-24	27-37	
9-12	15-21	27-35								7-9	11-17	20-27	9-14	16-24		7-10	13-17	19-27	
7-9	11-15	20-27								5-6	7-11	13-20	6-9	11-16		5-6	9-11	13-16	
11-13	18-23	31-38	48-61							9-12	15-21	25-34	12-17	22-30	35-47	9-14	16-23	24-37	
8-11	13-18	25-31	34-48							6-8	9-15	16-25	8-12	15-22	23-35	5-9	10-16	15-24	
6-8	11-13	20-25	30-34							5	6-9	11-16	5-8	10-15	15-23	5	7-10	10-15	
9-11	15-19	27-32	40-51							8-11	13-19	23-32	11-15	20-27	30-41	7-12	14-22†	21-35	29-47
7-9	11-15	20-27	30-40							5-7	8-13	14-23	7-11	13-20	20-30	7	8-14	12-21	17-29
5-6	9-11	15-20	22-30								6-8	11-14	5-7	9-13	14-20		6-8	9-12	12-17
8-10	13-17	23-30	36-46							7-9	11-16	19-27	9-13	17-23	26-35	6-10	11-18	17-27	24-38
6-8	10-13	18-23	27-36							5-6	7-11	14-19	6-9	11-17	17-26	6	7-11	11-17	15-24
5	8-10	14-18	21-27								5-7	9-14	6	8-11	12-17		5-7	8-11	10-15
6-8	12-15	21-25	31-39	33-40						6-8	9-14	17-24	8-11	15-20	23-30	5-9	10-16	15-25	21-34
5-6	9-12	17-21	24-31	27-33						5	6-9	11-17	5-8	9-15	14-23	5	6-10	9-15	12-21
5	7-9	13-17	19-24	21-27							6	7-11	5	6-9	9-14		5-6	8-9	10-12
6-7	10-12	18-23	27-34	28-33						5-6	8-11	14-20	7-9	12-17	18-26	5-7	8-13	12-20	17-27
5	7-10	14-18	19-27	23-28							5-8	9-14	7	8-12	12-18		5-8	7-12	10-17
	6-7	10-14	15-19	18-23							5	6-9		5-8	8-12		5	6-7	9-10
5-6	8-10	15-19	22-28	24-29						5	7-10	12-18	6-8	10-14	15-21	6	7-11	11-17	15-24
	6-8	12-15	16-22	20-24							7	8-12	6	7-10	10-15		7	6-11	9-15
	5-6	9-12	14-16	15-20								5-8		5-7	8-10			6	8-9
5	7-9	13-17	19-25	22-25	17-19	24-28	33-37	55-62	27-31		6-9	10-14	5-7	9-12	14-18	5	6-10	9-15	12-21
	6-7	10-13	15-19	17-22	14-17	20-24	28-33	46-55	23-27		6	7-10	5	6-9	9-14		6	7-9	9-12
	5	8-10	12-15	14-17	12-14	17-20	23-28	38-46	19-23			5-7		6	6-9			5-6	7-9
	7-8	12-15	18-22	19-23	15-17	22-25	29-33	48-55	24-27		5-7	9-13	6	8-11	12-17	5	5-9	8-14	10-19
	5-6	9-12	14-18	15-19	12-15	18-22	24-29	41-48	20-24		5	6-9		6-8	9-12		5	5-8	7-10
		7-9	10-14	12-15	10-12	15-18	20-24	34-41	17-20			6			6				5-7
	5-7	10-12	15-18	16-20	13-15	19-22	26-30	43-49	21-24		6	8-10	5	7-9	10-14		5-7	8-11	10-15
	5	8-10	12-15	13-16	11-13	16-19	22-26	36-43	18-21			5-8		5-7	8-10			5-6	7-9
		6-8	9-12	10-13	9-11	13-16	18-22	30-36	15-18			5		5	8				5
	6	9-11	14-16	14-17	12-14	17-20	23-27	39-44	19-22			7-10		6-8	9-12		6	7-9	9-12
		7-9	10-14	12-14	10-12	14-17	20-23	32-39	16-19			7		6	6-9			5	5-9
		5-6	8-10	9-12	8-10	12-14	16-20	27-32	13-16						6				5
					11-12	16-18	21-24	35-40	17-20										
					9-11	13-16	18-21	20-35	14-17										
					8-9	11-13	15-18	24-29	12-14										
					9-10	13-15	17-20	29-33	14-16										
					7-9	11-13	14-17	24-29	12-14										
					6-7	9-11	12-14	20-24	10-12										
					8-9	11-12	15-17	24-28	12-14										
					6-8	9-11	12-15	20-24	10-12										
					5-6	7-9	10-12	17-20	8-10										
					6-7	9-11	12-14	21-24	10-12										
					5-6	8-9	10-12	17-21	8-10										
					4-5	6-8	9-10	14-17	7 8										
					5½-6	8-9	11-12	18-20	9-10										
					4½-5½	7-8	9-11	15-18	7-9										
					4-4½	5-7	7-9	12-15	6-7										
					5–5½	7-8	9-11	15-18	8-9										
					4-5	6-7	8-9	13-15	6-8										
					3½-4	5-6	6-8	11-13	5-6										

NOTE: These columns are calculated for Glassteel Diffusers; for RLM Dome reflectors add 10% to obtain the approximate foot candle reading.

time switch should also be provided for automatic control of the installation at predetermined times.

Control outlets in each show window individually. Equip them with an automatic time switch. The time switch should be connected to control all show window circuits simultaneously.

f—Remote control

Where it is necessary to control a number of branch circuits in a group from one or more points and standard snap switches cannot handle the capacity involved, install remote control switches. Automatically operated remote control equipment will also serve to cut in the emergency system in hospitals, theatres, or large auditoriums.

In industrial occupancies, remote control equipment should be considered not only for lighting circuits but also of motors and temperature control. In many cases, this equipment will make the installation more flexible and less costly.

3. Feeders and Distribution

a—Panelboards

Install a panelboard at the termination of each feeder. This panelboard should provide protection devices for the branch circuits and when possible control devices as well. Determine the number of panelboards and their location by the number of branch circuits and the distribution of the load. The run from the panelboard to the first outlet should be as short as possible.

For each five circuits initially installed, the panelboard should contain at least one spare circuit. Where time switches are used, group all circuits controlled by the time switch. Extend spare circuits of flush type panelboards to the ceiling of the floor served or to the ceiling of the floor immediately below. Terminate these circuits or raceways in boxes suitably located for future additions.

b—Feeders

Calculate the feeder capacity according to the number of circuits the feeder supplies and to the load per circuit. Estimate the load for general illumination from the standard load tables on Pages 52 to 53. Divide the resulting wattage into circuits having a load of not more than 1000 watts per 15 amp. branch circuit. Add to this 1000 watts for each circuit not specifically designated as a lighting circuit, 500 watts for each spare circuit and the actual load of each heavy duty or special purpose circuit. To the total wattage so computed, demand factors may be applied as permitted by the Code.

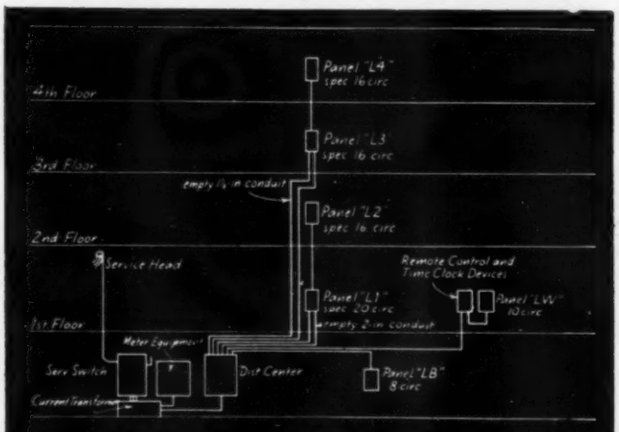
In all calculations of feeders, allow for a 50 per cent increase in load over the present system. Where the feeder capacity is not larger than No. 4 wire this excess capacity should be installed initially. Where feeders are large, use any suitable method listed under "Providing for future additions" on Page 48. Here no feeder should have a voltage drop of more than 1.5 per cent from the point of service entrance to the panelboard. When computing the drop, use the ultimate demand as stated above.

c—Feeder Distribution Center

In the design of the feeder distribution center, plan for future additions. This feeder distribution center can consist of a switchboard, a panelboard, or a group of enclosed switches or circuit breakers. Except where greatly oversize feeders are installed originally, provide for the later connection and protection of larger feeders or additional feeders. To do this, provide spare feeder circuits on the distribution center or design the equipment with additional space, bus capacity, and facilities for making connections when needed.

d—Service

Calculate the minimum size of the service equipment by adding together the loads of the individual feeders. See paragraph on feeders page 57. Demand factors may then be applied as permitted by the Code. Provide for 50 per cent addition to the calculated load and select the size of the service conductors accordingly. Where the calculated feeder size—including the 50 per cent addition for future load—does not become larger than 500,000 circ. mils install the feeders as part of the original installation. Where the calculated feeder size exceeds this point, study each case and determine what provisions should be made for future increases in the load.



Lighting Feeder System Riser Diagram
Insert Schedule of Raceway and Wire Sizes, on Riser Diagram unless a schedule is placed in Specifications

Example 13—PLANNING FEEDERS—*Riser diagrams make larger installations more definite for estimating and checking important elements of the job.*

e—Transformers

Where the project is large enough to justify the purchase and transforming of primary power and the structural design and layout of the building make it economical, consider the installation of one or more transformer stations. There are three types of stations.

1. Single station supplied by primary service conductors.
2. A master station supplied by primary service conductors, which in turn supply transformer substations located in various parts of the premises.
3. Several transformer stations in different locations or levels, all supplied by primary service conductors.

Before making the layout for transformer stations, consult the local inspection authorities and the local utility company.

What to Do for Power

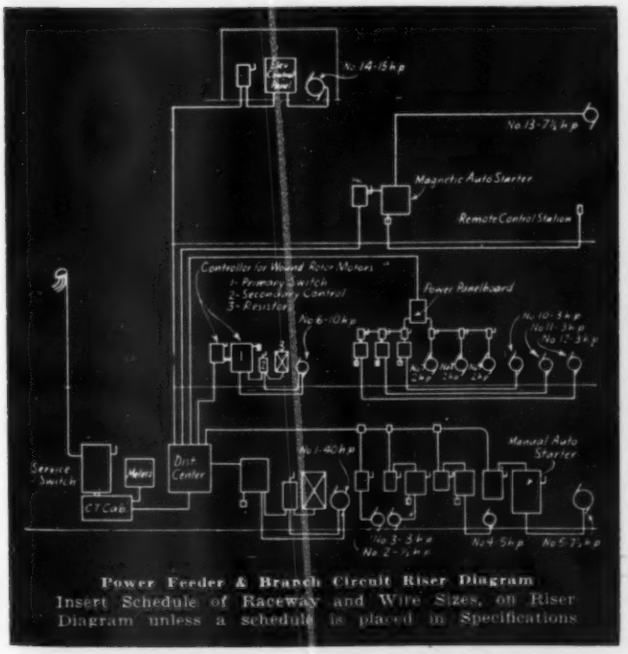
The applications for electric motors are so numerous and diversified that it is impossible to classify every condition which might be found while wiring for power. But there are basic wiring requirements common to most installations that form a natural foundation for power layout. The selection of the proper type of motors for the job, the proper voltage for the motors used and the other conditions of each installation, must always be considered in planning the wiring that must serve them.

A. PRINCIPLES OF FEEDER DESIGN

The wiring layout for a power system consists of feeders, sub-feeders and branch-circuits, substantially no different from a system for lighting. The recommendations for lighting given on the previous pages therefore apply. The feeder distribution centers and panelboards may be somewhat different in size and arrangement of protective equipment; but the rules for location, number of circuits, and provisions for future additions should be applied.

To meet varying factors in motor application and control, five methods of designing the individual feeders and branch-circuits should be considered. With all of them, the code rulings on conductor sizes should be observed. The carrying capacity of the motor branch-circuits should not be smaller than 125 per cent of the full load current of the motor.

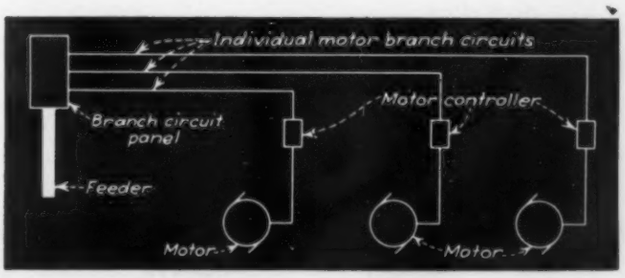
For services, feeders and sub-feeders, the current carrying capacity of the conductors should not be less than 125 per cent of the full load current of the largest motor plus the sum of the full load currents of all other motors on the same feeder or sub-feeder. Under special conditions a demand factor of less than 100 per cent can be applied, but only by permission of the local inspection authority.



Example 14—POWER LAYOUTS *are made clear by riser diagrams which include all the motors.*

1. *Method*

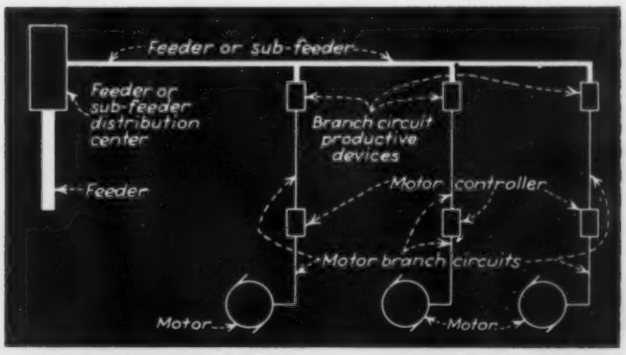
An individual branch-circuit with its proper protective device is installed for each motor. This is the most commonly used type of layout and can be applied under any conditions. See example No. 15.



Example 15—METHOD NO. 1—*Individual circuits from the panel to each motor and controller.*

2. *Method*

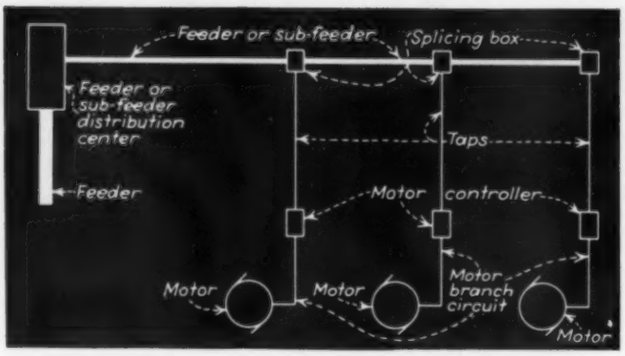
A sub-feeder is carried around the floor and the individual branch-circuit protective devices are mounted at the points where the taps for the individual motors are made. This method saves the installation of a great number of home runs to the centrally located branch panel. See example No. 16.



Example 16—METHOD NO. 2—*A common feeder to several motors with local protective devices.*

3. *Method*

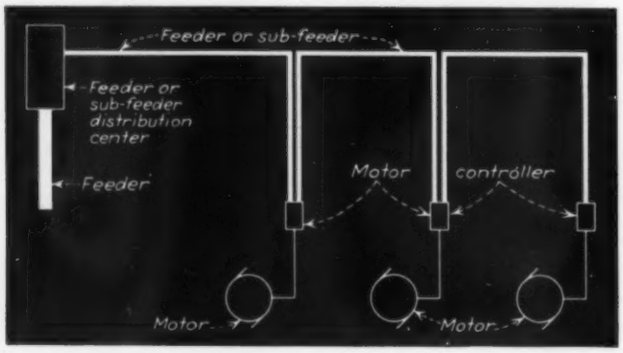
The taps to the individual motors are connected directly to the heavy feeder and no individual branch circuit protective devices are used. With this method, the limitation of section 2434d of the 1937 Code must be observed. See example No. 17.



Example 17—METHOD NO. *3—A common feeder and taps of smaller wire to motors.*

4. *Method*

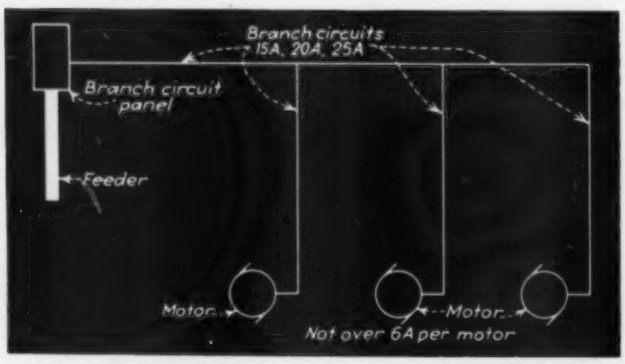
The feeder is connected directly to the controller of each motor. This method can be used advantageously where the feeder or sub-feeder comes very close to the individual motors and where this feeder is not too large in size. See example No. 18.



Example 18—METHOD NO. *4—The common feeder looped directly to several motor controllers.*

5. *Method*

Can be employed only where a group of small motors, each having a full load rated current of not over 6 amp. are to be installed on a circuit. This method is mainly suggested as a means of connecting small commercial appliances or similar devices to available lighting or special purpose circuits. See example No. 19.



Example 19—METHOD NO. *5—Intended for connecting several small motors to one branch circuit.*

The first four methods will serve equally well for any motor installation. The fifth method is not suitable for large motor leads. In selecting any one of these five methods for a given problem of power application, economy in cost of installation, flexibility and adaptability to the specific job should be considered.

B. VOLTAGE DROP

The total voltage drop from the service equipment should never exceed 5 per cent. Where the conductor size permitted by the Code for the required current will not maintain a voltage drop of 5 per cent, or under, the conductor size should be larger.

Where the system operates at a voltage of 208 volts or higher, limit the voltage drop to 1 per cent in the branch-circuit. This will allow 4 per cent in the feeders, which will normally permit the use of feeder conductors in accordance with the maximum current carrying capacities specified in the Code.

In all cases where the drop exceeds 3 per cent, compute the total watt hours per year consumed by the copper losses. See if it is economical to install larger conductors in order to reduce these losses.

C. PROVISION FOR INCREASED LOADS

Follow the recommendations given on page 48 under "Providing for Future Additions." Take care of possible changes in the plant layout and shifting of equipment. For it often happens that while the total load of a plant does not increase, one department will take on added load while other departments lose some of their load as initially installed. Design the feeder system so that shifting of equipment will not cause costly wiring alterations. By selecting the proper materials and providing sufficient feeder capacity and panels, an industrial plant can be so wired that major changes will not have to be made for many years to come. See also section "Selecting Most Economical System" page 49.

D. PREPARING MOTOR AND CONTROL SCHEDULE

In planning wiring for a large number of motors show on the floor plans the location, size, h.p. rating, and the location and type of controller for each motor. Assign a number to each motor and prepare a motor schedule giving

1. Motor number
2. Location
3. H.P. rating
4. Speed
5. Type of motor
6. Type of machine driven
7. Type of controller

A motor schedule, including all these items, should be made part of the specification to avoid errors and later changes. Care and accuracy in preparing this schedule is of great practical value in giving a clear picture of the motor requirement over the system and insuring against errors and omissions.

Provision for Heating Load

Wiring for electric heating equipment does not present any unusual problem. In most cases, the load is non-inductive and power factor problems rarely affect the wiring layout. The sections on feeders, sub-feeders and panelboards under "What to do for Lighting" can usually be followed.

There are many different uses of electric heating equipment, however, and the installation of some of the equipment may at times seriously influence the entire wiring layout. Four classes of equipment will be encountered.

A. SMALL HEATING UNITS

These are normally made in three general types—cartridge units, strip heaters and tubular units. Each type is available in many different forms to fit specific purposes including:

1. Air heating in crane cabs.
2. Watchmen's houses and out of the way places.
3. Annealing, baking and drying ovens.
4. Boilers, kettles, sterilizers, tanks and vats for compounds, fluids and metals.
5. Heaters for press molds, platens for plastics and revolving rolls.

B. INDUSTRIAL HEATING CABLE

While originally designed for soil heating, this cable has found many applications in industry on account of its flexibility. It is normally used where it is desired to apply a low even heat over a large surface.

C. ELECTRIC OVENS

Used for baking and finishing of metal parts, drying operations, low temperature heat treating, aging and tempering, processing of food products and many other purposes.

D. ELECTRIC FURNACES

Used for heat treating and for melting. For melting, electric arc or high frequency current equipment may also be used.

Practically all electric ovens and furnaces and a large portion of the other electric heating equipment is controlled automatically in order to obtain even and continuous heat. In larger installations, the controller is of the recording type, so that a permanent record of the performance of the equipment can be kept. So special feeders and panelboards must be installed.

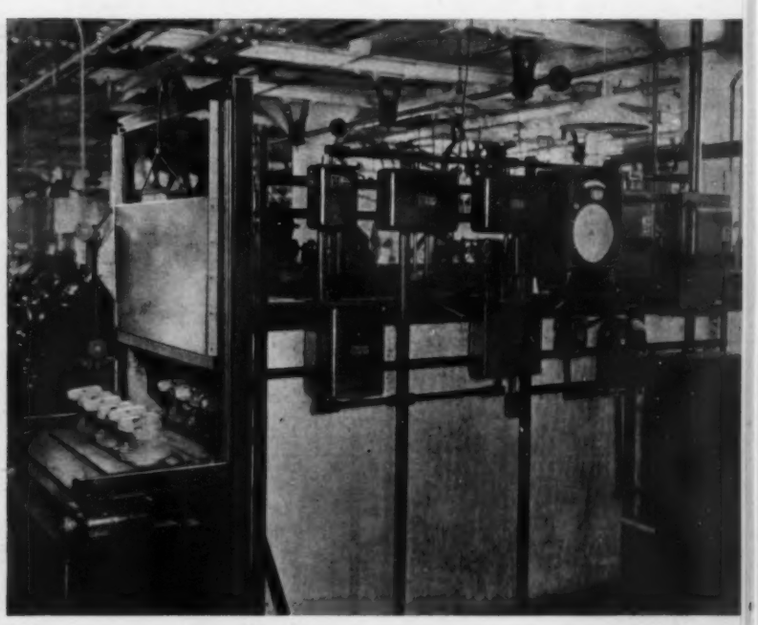
When small equipment is used, decide first to which system—light or power—the heating equipment should be connected. Increase feeders, subfeeders, and branch circuits accordingly.

Where machines are equipped with auxiliary heating equipment, the motor feeder layout usually will be affected. The nature of the auxiliary heating equipment and its capacity, must be known before making the layout.

Where portable equipment is used extensively the feeder, subfeeder, and branch circuit must have sufficient capacity to carry the increased load wherever it might be connected. Provide special or heavy duty outlets for the portable heating equipment, where needed.

POWER WIRING *must serve specific loads and processes. So every motor and control becomes an individual layout problem in planning and coordinating the system. Safe and convenient controls are also important.*

PLANNING SUPPLY *for modern ovens and furnaces must rest on definite knowledge of the electrical load. Then the wiring system can be planned to meet various operating and control conditions satisfactorily.*



Signaling and Communication

Some type of signaling or communication system is used in practically every installation. There are a great number of systems available for almost any purpose, from the simple front and back door bell in a private residence to complicated equipment for signaling and communication in theatres and other public or industrial buildings. Writing a specification for commercial, institutional or factory buildings calls for good judgment by the specification writer, if the proper system is to be provided for each individual case.

A. PLANNING THE SIGNAL LAYOUT

To clearly indicate signaling systems in the electrical plan and specification—

1. Adopt symbols to identify each kind of signaling device and associated apparatus to be used.
2. Indicate on the plans, by these symbols, where each station or device is to be located.
3. Prepare a riser plan or indicate on floor plans, the circuiting methods to be employed.
4. Follow the detailed instructions of the manufacturer in determining kinds and sizes of wire and signal cable and methods of connection.

Because of the variety and operating contrasts in systems of different manufacturers, it requires unusual care to install one wiring system to serve more than one signaling system. Every system has its special devices, stations and associated apparatus. The units of equipment and the wiring methods must be carefully selected to provide a complete system. In the larger layouts, such as a program and clock system for a school or a nurses or a patients call system for a hospital, a detailed schedule of the requirements should be obtained from the manufacturer.

B. WRITING THE SIGNAL SPECIFICATION

The data secured from manufacturers on equipment and wiring will provide the essential information for the specification. List audible or visual signals, power units, relays, control panels or other associated items. In some instances a recommended form of specification may be secured from the manufacturer, which covers every item needed for the system. Regardless of the system, however—

1. Describe the system desired and how it must function.
2. State its operating voltage and source of power supply.
3. Specify the wiring method to be employed.
4. List in specifications or riser plans a schedule of stations and auxiliary devices.
5. Include name of manufacturer, and catalog number of the system.
6. Where a variety of devices must be provided from several suppliers, describe each important item in addition to manufacturer's name and catalog number.

The eleven types of signaling systems in common use are discussed in the following order.

C. Burglar Alarm Systems
D. Fire Alarm Systems
E. Sound Amplification Systems
F. Doctors Paging Systems
G. Program Systems
H. Electric Clock Systems
I. Private Telephone Systems
J. General Paging Systems
K. Nurses' Calling Systems
L. Public Telephone Systems
M. Watchman Systems
N. Electronic Communicating Systems

C. BURGLAR ALARM SYSTEMS

1. *Selection*

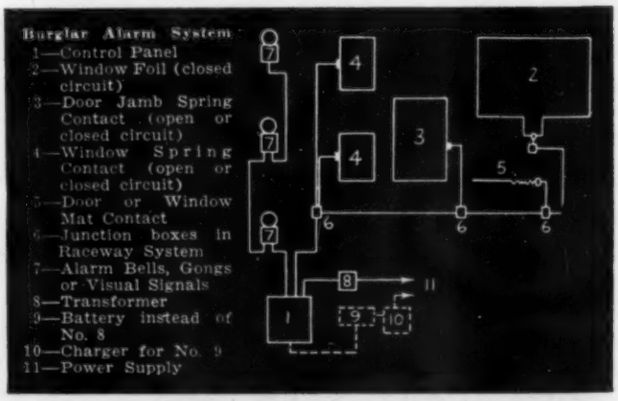
Consists of one or more contact making devices, connected to operate one or more alarm devices, located on the premises or in a central office or both. Contact devices may be manually operable by using push buttons, regular switches, floor treadles. They may be automatically operated by concealed contact-making springs on doors, gates and windows, stairtread contacts, special locks on door and vaults, continuous circuits or foil applied to plate glass, or photronic light beams. Alarm devices may be audible signals—gongs, bells, buzzers, horns, sirens or chimes—or visual signals.

When a system is under daily supervision it includes a control cabinet, containing test relays and a trouble alarm device to give warnings when something is out of order in the power supply or the circuit wiring. With a control cabinet, the entire system can also be divided into several circuits.

A further improvement in the system would be the inclusion of a time switch, so that the alarms will work only at predetermined times. Also, to show the location where the alarm originated, the cabinet can be equipped with annunciator drops. Where an alarm is to register in police stations or the offices of patrol agencies, install special relays to operate the leased circuits to these stations.

2. *Specifications*

In specifying this system, major items will be: contact devices, signals—audible or visible, the power supply—


Burglar Alarm System
1—Control Panel
2—Window Foil (closed circuit)
3—Door Jamb Spring Contact (open or closed circuit)
4—Window Spring Contact (open or closed circuit)
5—Door or Window Mat Contact
6—Junction boxes in Raceway System
7—Alarm Bells, Gongs or Visual Signals
8—Transformer
9—Battery instead of No. 8
10—Charger for No. 9
11—Power Supply

EXAMPLE 20—*Principal elements of burglar alarm systems.*

dry cell batteries, storage batteries and chargers, transformers, control cabinet, indication relays, time switch and relays for leased wire alarm circuits.

D. FIRE ALARM SYSTEMS

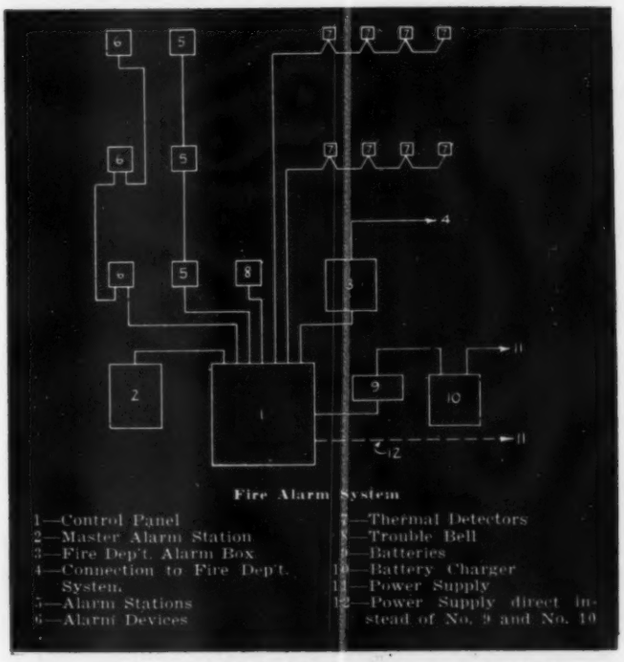
1. Selection

a. Open circuit, non-code, non-supervised system.

Alarm will sound on all signal stations whenever any station is operated. Because of the open circuit, this system can not be readily tested, except by making a check in each station. This system therefore is not approved by the National Board of Fire Underwriters. This system can only be used for a comparatively small number of stations except where a relay control panel is installed.

b. Closed circuit, non-code, supervised system.

By operation of any one station, a gong is sounded six times on all signal stations. In case the power supply



EXAMPLE 21—*Principal elements of the alarm systems.*

should fail or a circuit is out of order on any point, a small trouble bell will ring continuously. This system is easily tested and is suitable only in buildings where the number of occupants is small enough so that a general alarm will not cause a panic.

c. Closed circuit, box code supervised system.

Gong identifies by code the station from which the alarm was given. The gong circuits are usually operated through relays on a control panel. A trouble bell will indicate disarrangement of the system in the same way as accomplished in the non coded system. Since this system gives a general alarm, use is naturally restricted to buildings with a small number of occupants.

d. Closed circuit, box code, pre-signal, supervised system.

Sends a coded signal through a relay control panel to one or more pre-signal bells. After investigation, an attendant can send a general alarm from any alarm box by inserting a key. A trouble bell gives warning when the system is out of order. System may also include a relay to operate a special fire department alarm box. Suitable for hospital and institutional buildings, where it is advisable to sound a general alarm only after an investigation has been made.

e. Automatic fire alarm system.

Gives the alarm by thermal detectors, installed in suitable locations, which open the circuits after temperature at any device exceeds a predetermined limit. System is closed circuit and supervised.

2. Specifications

In specifying this system, major items will be:—alarm stations, special fire department alarm box, alarm devices, control panels, trouble bell, thermal detectors.

E. SOUND AMPLIFICATION SYSTEMS

1. Selection

In its simplest form, this system consists of an input device—either microphone, phonograph, or radio receiving set—an audio frequency amplifier and one or more speakers.

The use of high fidelity amplifiers will result in a minimum of distortion and will uniformly amplify all audio frequencies, within reasonable limits. The necessary output capacity of the amplifier depends upon the number and type of speakers to be supplied. Speakers may be magnetic, electro-dynamic type and the permanent magnet dynamic type.

a. Magnetic speakers.

Usually preferred when a large number of speakers have to be operated from one amplifier and where high output and high fidelity are not of prime importance on account of their lower power consumption. To control the volume individually, a volume control should be included on each speaker.

b. Electro-dynamic speakers.

Used when high output and high fidelity are required. Field excitation current should be supplied from the amplifier or furnished by a power supply unit to each individual speaker or group of speakers. Connect the power supply unit to the 110 volt system. Provide individual volume control in the same way.

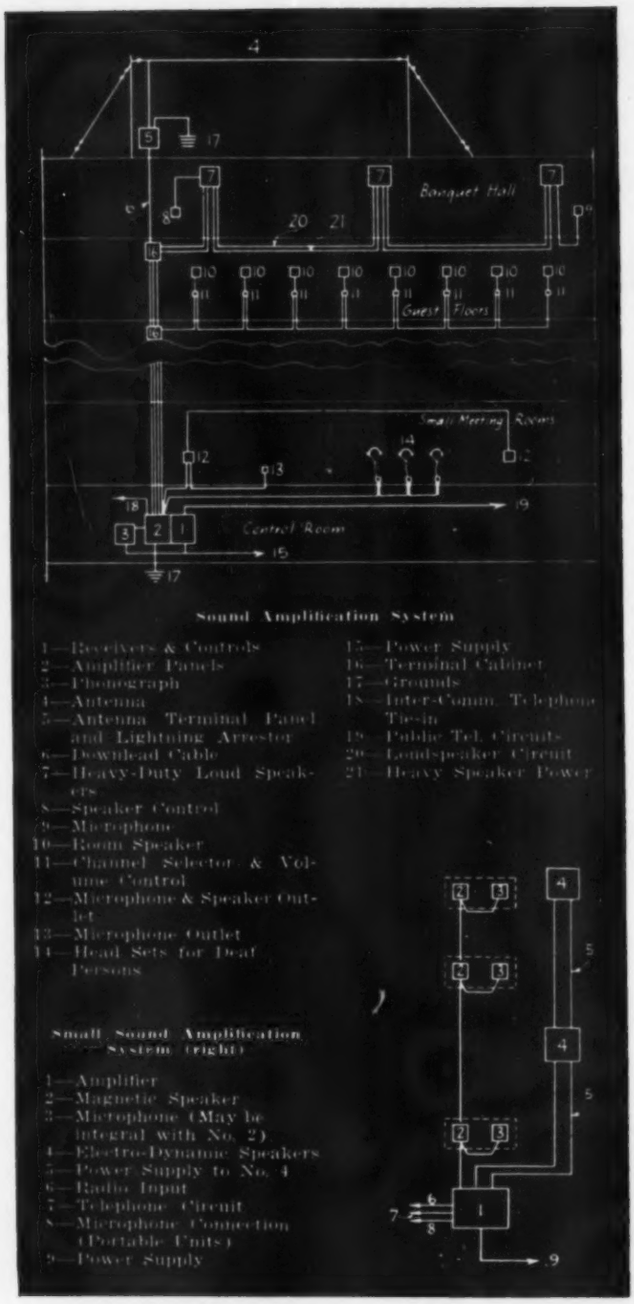
c. Permanent magnet dynamic speakers.

Used in place of electro-dynamic speakers for high fidelity and sound output. No provisions need be made for field excitation current.

d. Multi-channel system.

Install where two or more programs are to be transmitted to each speaker. This is a combination of two or more elementary systems, each speaker supplied with a switch for selecting the desired program. Extensively used in large hotels.

A control panel is usually installed for the mounting of the equipment and the controls, except in very simple systems where all equipment and controls are mounted in a cabinet.



EXAMPLE 22—*Principal elements of sound amplification systems.*

2. *Wiring Methods*

When wiring for a sound amplification system, whether installed in raceway or not, install a shielded pair from the microphone outlet to the control panel. From the control panel to the speaker outlets use twisted pairs in raceways, except for high output multi-channel systems where shielded pairs may be necessary. Do not run speaker field circuit wires in the same raceway as the output circuits from the amplifier.

3. *Specifications*

When specifying this system, major items will be: speakers, control panel, radio receiving sets and amplifiers, phonograph turntable and pickup, horns, microphones and stands, microphone outlet devices, shielded conductors and special outlets.

F. DOCTORS PAGING SYSTEMS

1. *Selection*

a. Lamp annunciator system.

Lamp annunciators are located on each floor, and operated from a switching or plugging device at the telephone switchboard. System may include an audible auxiliary signal device, or be operated from a signal transformer or on 110 volts. The lamps must be flashed manually.

b. System of lamp flashing signals.

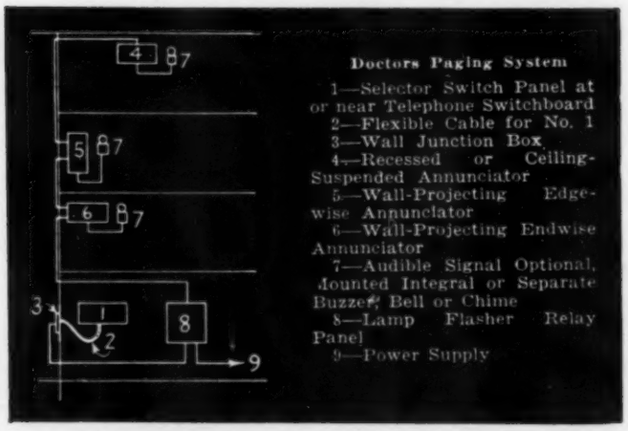
Depending on the system used, two or three doctors can be called by coded signals from a central keyboard and flasher equipment with or without an audible auxiliary signal. Lamp annunciators have indicating numerals so arranged that a staff of up to 120 doctors can be paged. The lamps are flashed automatically for a definite time cycle or until the doctor responds. Number of doctors that can be called at a time depends on the number of wires used.

c. In and out recorder system.

Similar in design to a simple lamp annunciator system. It indicates by lamp annunciators when certain doctors are in or out of the hospital or in or out of certain parts of the hospital. The switching or plugging device should be located convenient for doctors to check in or out.

4. *Specifications*

In specifying this system, major items will be: annunciators, selector keyboards, plugging or switching devices, relay and flasher panel, terminal cabinets, transformer, flexible multi-conductor cable and special outlet boxes.

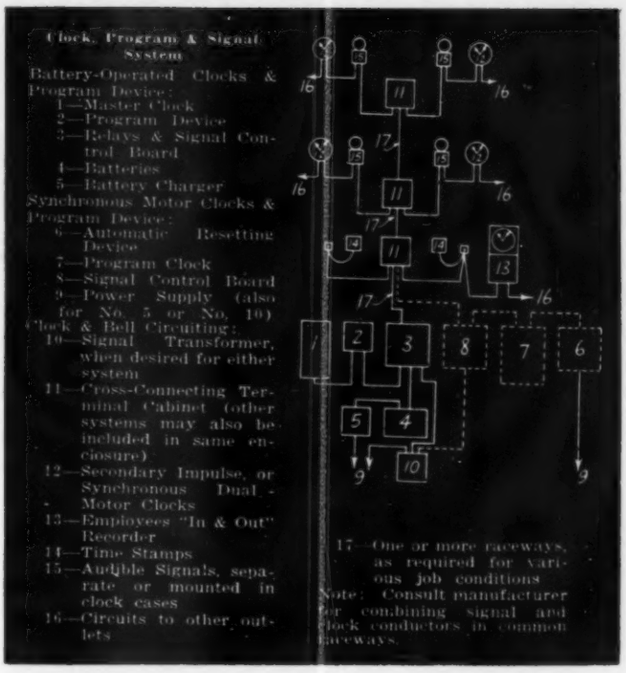

Doctors Paging System
1—Selector Switch Panel at or near Telephone Switchboard
2—Flexible Cable for No. 1
3—Wall Junction Box
4—Recessed or Ceiling-Suspended Annunciator
5—Wall-Projecting Edgewise Annunciator
6—Wall-Projecting Endwise Annunciator
7—Audible Signal Optional, Mounted Integral or Separate Buzzer, Bell or Chime
8—Lamp Flasher Relay Panel
9—Power Supply

EXAMPLE 23—*Principal elements of doctors paging systems.*

G. PROGRAM SYSTEMS

1. *Selection*

Consists of one or more signal devices—bells, buzzers, sirens—and a program instrument which automatically closes one or more circuits causing the signal devices to operate on one or more predetermined schedules. The


Clock, Program & Signal System
Battery-Operated Clocks & Program Device:
1—Master Clock
2—Program Device
3—Relays & Signal Control Board
4—Batteries
5—Battery Charger
Synchronous Motor Clocks & Program Device:
6—Automatic Resetting Device
7—Program Clock
8—Signal Control Board
9—Power Supply (also for No. 5 or No. 10)
Clock & Bell Circuiting:
10—Signal Transformer, when desired for either system
11—Cross-Connecting Terminal Cabinet (other systems may also be included in same enclosure)
12—Secondary Impulse, or Synchronous Dual-Motor Clocks
13—Employees "In & Out" Recorder
14—Time Stamps
15—Audible Signals, separate or mounted in clock cases
16—Circuits to other outlets
17—One or more raceways, as required for various job conditions
Note: Consult manufacturer for combining signal and clock conductors in common raceways.

EXAMPLE 24—*Principal elements of program systems.*

program instrument is driven by a clock mechanism which can be incorporated in the master clock, when a master and secondary clock system is used. It can be designed so separate circuits are on separate schedules or to omit all signals during a 6 or 12 hour period and during one or more days of each week.

The signaling devices are usually gongs or sirens, connected in multiple, or sometimes in series. The operating voltage is commonly 24 volts d.c. or 24 or 110 volts a.c. A push button panel, properly installed, will operate each device manually. Cross connecting straps on these panels connect each device to each program.

2. *Specifications*

In specifying this system, major items will be: program instrument, control panel, push button panels, cross connecting straps, power supply, and signal devices.

H. ELECTRIC CLOCK SYSTEMS

1. *Selection*

a. Synchronous clocks with no control.

Satisfactory only where power interruptions are very infrequent, since each clock has to be reset individually in case the power fails. Install special clock circuits with not more than 25 clocks on one circuit.

b. Synchronous clocks with master resetting control.

Install where the large number of clocks makes it better to reset from a central control panel. With standard synchronous clocks, install a frequency changer to operate the clock at double speed after an interruption of service has occurred. With dual motor clocks, the second motor speeds up the clocks and brings them to the correct time after an interruption of service.

Both methods of regulation may be manual or automatic. If clock must be kept running during intervals of service interruption, install emergency battery equipment and a motor generator set to supply a.c. power temporarily to the system.

c. Master and secondary clock system.

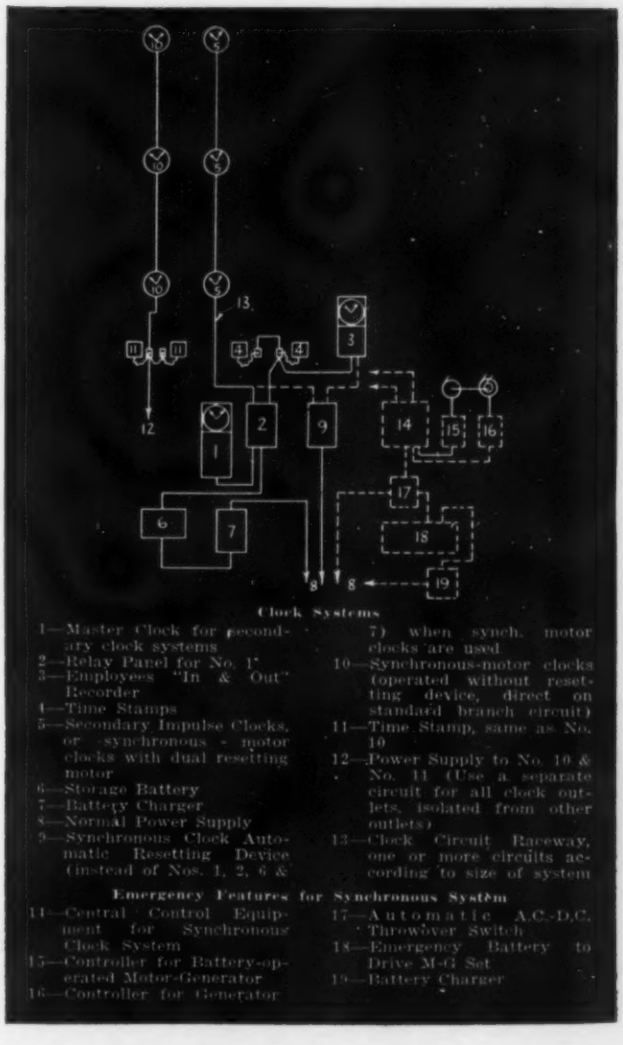
The master clock itself is a synchronous clock which sends out impulses once an hour to bring all secondary clocks into perfect synchronism in case they are slow or fast. The secondary clocks are electro-magnets, energized once a minute or oftener by a circuit closing device in the master clock.

d. Time stamps or employees time recorders.

Synchronous or secondary clock equipped with mechanical devices. Where operated from a master clock, the additional power used by the mechanical devices must be provided for in the wiring layout.

2. *Specifications*

In specifying this system, major items will be: clocks, time stamps, control panel, battery and charging equipment or motor generator set.


Clock Systems
1—Master Clock for secondary clock systems
2—Relay Panel for No. 1
3—Employees "In & Out" Recorder
4—Time Stamps
5—Secondary Impulse Clocks, or synchronous-motor clocks with dual resetting motor
6—Storage Battery
7—Battery Charger
8—Normal Power Supply
9—Synchronous Clock Automatic Resetting Device (instead of Nos. 1, 2, 6 & 7) when synch. motor clocks are used
10—Synchronous-motor clocks (operated without resetting device, direct on standard branch circuit)
11—Time Stamp, same as No. 10
12—Power Supply to No. 10 & No. 11 (Use a separate circuit for all clock outlets, isolated from other outlets)
13—Clock Circuit Raceway, one or more circuits according to size of system
Emergency Features for Synchronous System
14—Central Control Equipment for Synchronous Clock System
15—Controller for Battery-operated Motor-Generator
16—Controller for Generator
17—Automatic A.C.-D.C. Throwover Switch
18—Emergency Battery to Drive M-G Set
19—Battery Charger

EXAMPLE 25—*Principal elements of clock systems.*

I. PRIVATE TELEPHONE SYSTEMS

1. *Selection*

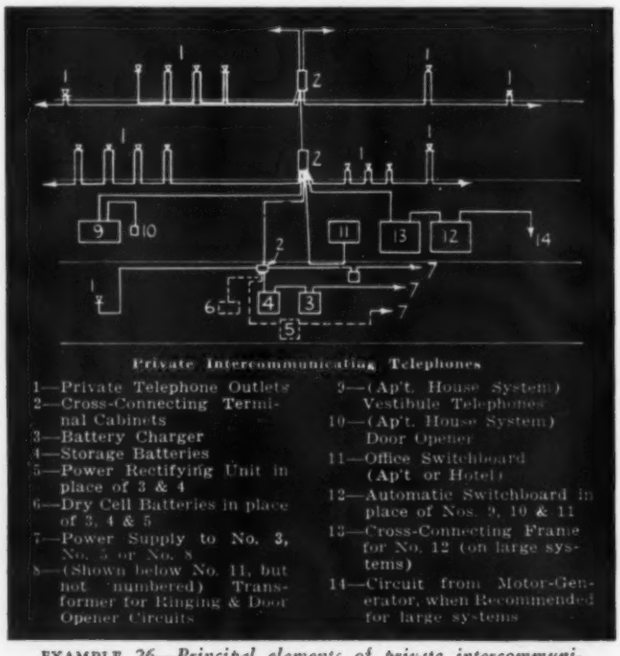
There are a great number of private telephone systems each having its own advantage and suiting its own purpose, so select the system only after consultation with the manufacturer.

a. Common ringing—common talking system.

Install where calls are made infrequently. A prearranged code must be used when calling any one station, since the bells on all stations ring when each call is made.

b. Selective ringing and common talking.

Similar to the above except that only the bell on the called station will ring. One conversation only can be


Private Intercommunicating Telephones
1—Private Telephone Outlets
2—Cross-Connecting Terminal Cabinets
3—Battery Charger
4—Storage Batteries
5—Power Rectifying Unit in place of 3 & 4
6—Dry Cell Batteries in place of 3, 4 & 5
7—Power Supply to No. 3, No. 5 or No. 8
8—(Shown below No. 11, but not numbered) Transformer for Ringing & Door Opener Circuits
9—(Ap't. House System) Vestibule Telephones
10—(Ap't. House System) Door Opener
11—Office Switchboard (Ap't or Hotel)
12—Automatic Switchboard in place of Nos. 9, 10 & 11
13—Cross-Connecting Frame for No. 12 (on large systems)
14—Circuit from Motor-Generator, when Recommended for large systems

EXAMPLE *26—Principal elements of private intercommunicating systems.*

carried on at a time. Not more than 12 stations should be installed.

c. Selective ringing and selective talking system.

Permits several conversations at one time. Any station can call and converse with any other station without interfering with the remainder of the system. About 21 stations is the practicable limit.

d. Master annunciator.

Master annunciator permits communication between one master station and up to 100 outlying stations. Incoming calls are registered on the annunciator at the master station, the attendant then plugs in a jack connected with the calling station and answers the call. By pressing a calling button and plugging, the attendant can call any outlying station. Frequently used in apartment houses where a doorman is continuously on duty.

e. Private exchange switchboard systems and private exchange automatic systems.

Provide complete intercommunication service. Use where the number of stations exceeds the practical limit of a selective ringing and selective talking system. Private exchange automatic systems do not need an operator, of course.

f. Apartment house systems.

Modified selective ringing and common talking systems with or without special janitor and special trademen's stations. A telephone is provided in the vestibule and each apartment. A person in the vestibule can call and talk to any apartment. Each telephone is equipped with a push button to operate the door opener and a push button and bell or buzzer is provided at the front and rear door to each apartment. If a janitor station is added, the janitor can call and talk to any apartment and any apartment can call and talk to the janitor. The janitor and tenants in any apartment can also operate the door opener. The addition of a tradesmen station makes it possible for tradesmen at their entrance to call and talk to any apartment.

2. *Specifications*

When specifying this system, major items will be: telephones—surface or flush wall type, desk type, janitor station, tradesmen station—cable and auxiliary devices and equipment as listed in the accompanying table.

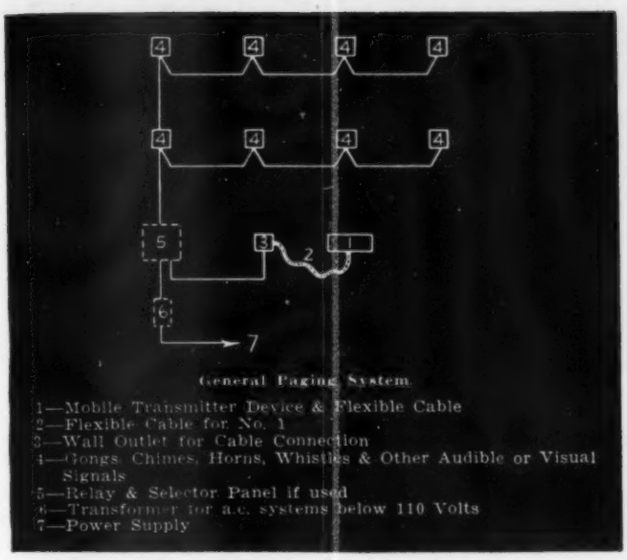
Equipment List for selecting devices for inter-communicating telephone systems — SYSTEM →	Two-Station	Common Ringing, Common Talking	Selective Ringing, Common Talking	Selective Ringing, Selective Talking	Master Annunciator	Switchboard System	Automatic System	Apartment House System	Apartment House System	Apartment House System
Dry-cell talking and ringing battery	X									
Dry-cell talking battery and transformer for ringing, or Storage battery and charger for talking and transformer for ringing, or Rectifier unit		X	X	X	X	X	X	X	X	X
Switchboard						X				
Automatic Selectors							X			
Master Annunciator					X					
Cross connecting cabinet					X	X	X			
Terminal cabinets			X	X	X	X	X			
Letter boxes								X	X	X
Door opener								X	X	X
Pushbuttons (for front and rear door)					X			X	X	X
Bell and buzzer (for front and rear door)					X			X	X	X

J. GENERAL PAGING SYSTEMS

1. *Selection*

a. Central manual signaling system.

Consists of a number of push buttons for the control of signaling circuits leading to audible or visible signals. If more than one person are to be called and a predetermined code is necessary, some systems provide that certain push buttons operate to only certain parts of the building.


General Paging System
1—Mobile Transmitter Device & Flexible Cable
2—Flexible Cable for No. 1
3—Wall Outlet for Cable Connection
4—Gongs, Chimes, Horns, Whistles & Other Audible or Visual Signals
5—Relay & Selector Panel if used
6—Transformer for a.c. systems below 110 Volts
7—Power Supply

EXAMPLE 27—*Principal elements of general paging systems.*

b. Central mechanical system.

Signals to various portions of a building are transmitted by the operation of mechanical devices which sustain the signals over a period of time. After starting the mechanical device, coded signals are transmitted without further attention until the paged person responds or the transmitter is stopped or a complete predetermined number of impulses has been given. Signal can be given to all stations simultaneously or to certain portions of the building only.

The best location for the transmitter is usually near the telephone switchboard operator. Transmitter may be a selector keyboard for operating a separate set of relays or a mechanically driven device for direct switching of coded impulses without relays.

2. Specifications

In specifying this system, major items will be: selector, selector relay panel, transmitting device, flexible cable, transformer, signals, special relays and outlet boxes.

K. NURSES CALLING SYSTEMS

1. Selection

a. Simple annunciator system for small hospital.

Patient pushes a button or operates a switch that drops a signal at the annunciator located at the nurses station. Audible signals may be added to the annunciator but lamp signals should not be combined with such a system.

b. Lamp annunciators system, suitable for hospitals of all sizes.

When a calling station is operated, a lamp signal and auxiliary audible signals indicate at one or more annunciators. In wards, calling stations can be equipped with pilot lamps to indicate which patient has called for a nurse. Lamp signals are provided in the corridors above the entrance to each room or ward. The signals usually stay on until turned off by a nurse. Audible signals are usually of short duration.

The annunciators at the nurses station are normally equipped with numbered lamp lenses or luminous cover plates corresponding with the numbers of the calling stations which the annunciator serves. An additional annunciator can be installed in the diet kitchen. A master annunciator to indicate all calls can be installed in the superintendent's office.

c. Master recording device.

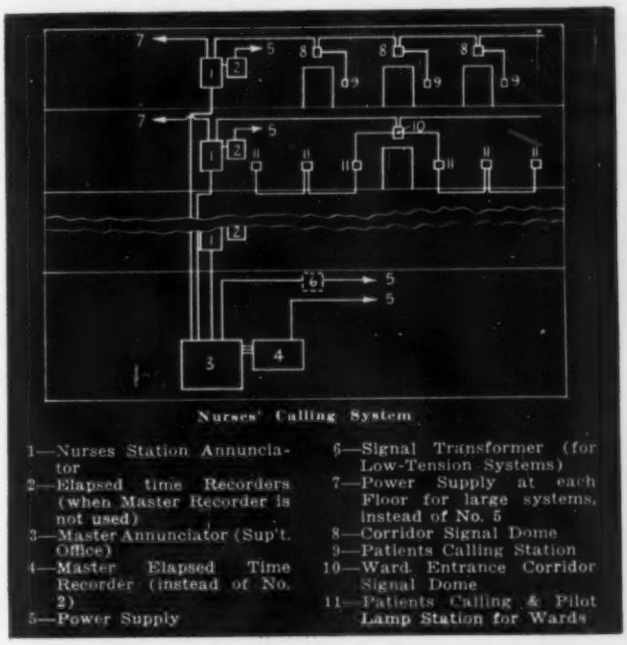
Provides a chart record of the time elapsed between patients call and nurses arrival. Separate recorders may be provided for certain floors in cases where a master recorder would be too expensive.

d. Emergency calling system.

Patient or nurse can indicate an emergency by lighting separate lamps of a distinctive color or by easily recognized audible signals. Locate operating devices at one or more suitable locations.

e. Nurse-patient talking system.

Employs fixed or portable microphones and speakers so patients can speak with their respective nurses. The nurses station consists of a terminal cabinet, an annunciator and keyboard control unit for switching a patient's conversation to a nurses microphone and speaker instrument. System may be operated independent or in conjunction with a modified lamp annunciator system.


Nurses' Calling System
1—Nurses Station Annunciator
2—Elapsed time Recorders (when Master Recorder is not used)
3—Master Annunciator (Sup't. Office)
4—Master Elapsed Time Recorder (instead of No. 2)
5—Power Supply
6—Signal Transformer (for Low-Tension Systems)
7—Power Supply at each Floor for large systems, instead of No. 5
8—Corridor Signal Dome
9—Patients Calling Station
10—Ward Entrance Corridor Signal Dome
11—Patients Calling & Pilot Lamp Station for Wards

EXAMPLE 28—*Principal elements of nurses calling systems.*

2. Specifications

In specifying this system, major items will be: patients, ward and emergency calling stations, microphone and speaker stations, sound amplification equipment, annunciators, elapsed time recorder, corridor domes, signal lamps, audible signals, transformers, terminal cabinets, special cables, special outlet boxes.

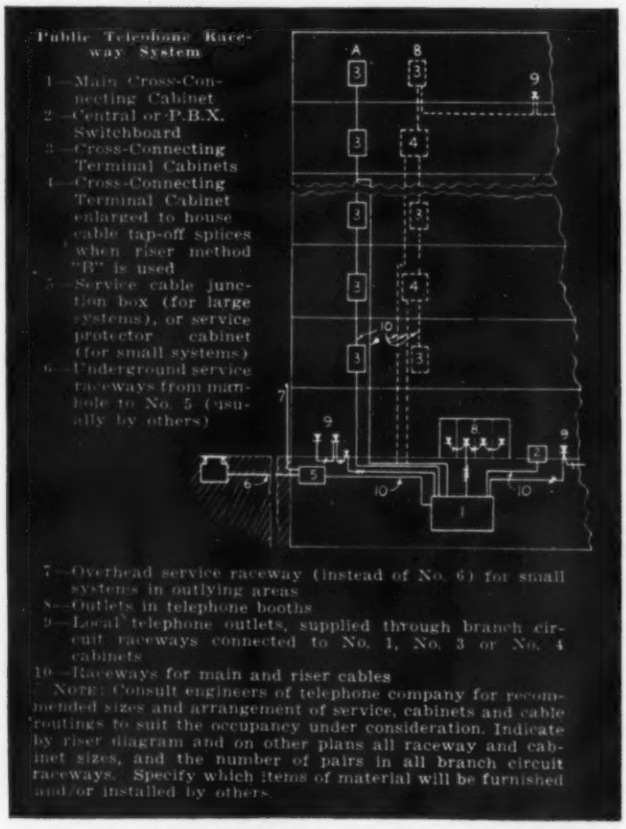
L. PUBLIC TELEPHONE SYSTEM

1. *Selection*

When buildings are equipped with public telephone systems, the contractor should apply the raceway system only. Consult the telephone company. Any one of five systems may be required—

a. A single station.

Affords only calling and receiving calls at a single point.


Public Telephone Raceway System
1—Main Cross-Connecting Cabinet
2—Central or P.B.X. Switchboard
3—Cross-Connecting Terminal Cabinets
4—Cross-Connecting Terminal Cabinet enlarged to house cable tap-off splices when riser method "B" is used
5—Service cable junction box (for large systems), or service protector cabinet (for small systems)
6—Underground service raceways from manhole to No. 5 (usually by others)
7—Overhead service raceway (instead of No. 6) for small systems in outlying areas
8—Outlets in telephone booths
9—Local telephone outlets, supplied through branch circuit raceways connected to No. 1, No. 3 or No. 4 cabinets
10—Raceways for main and riser cables
NOTE: Consult engineers of telephone company for recommended sizes and arrangement of service, cabinets and cable routings to suit the occupancy under consideration. Indicate by riser diagram and on other plans all raceway and cabinet sizes, and the number of pairs in all branch circuit raceways. Specify which items of material will be furnished and/or installed by others.

EXAMPLE 29—*Principal elements of public telephone raceway systems.*

b. A main station with extensions.

Provides for one incoming line but calls can be answered from several points. Inter-communicating between these points is not possible without auxiliary equipment.

c. A private branch exchange.

Provides for complete inter-communication. Operators must be on duty at all times when the system is being used.

d. An automatic private exchange.

Requires operators for incoming calls only, since calls between local station and outside calls are made through the automatic equipment. This will result in a considerable saving on operators in a large system.

e. A distribution system for a multiple occupancy building.

Any of the tenants might require any one of the aforementioned systems. So the distribution system should be initially laid out in such a way that trunk lines can be run to centrally located points from where the individual tenants can be served. This will accomplish a large degree of flexibility.

2. *Specifications*

When specifying this system, major items will be: raceways, outlet boxes, protector boxes, pull boxes, cross connection boxes, terminal boxes, splice boxes.

M. WATCHMEN SYSTEMS

1. *Selection*

a. Battery type systems.

Used with time detector and with or without clock to provide daily records of one or more watchmen. Wires run to all watchmen stations from a central detector. When a watchman inserts a key in any one station, the detector prints or perforates upon a clock-driven paper roll or chart the exact time a specific station has been visited. In some cases an auxiliary clock, electrical or mechanical, is provided in the detector cabinet. The system usually operates 4 to 60 stations. A battery and charging equipment is needed for current supply.

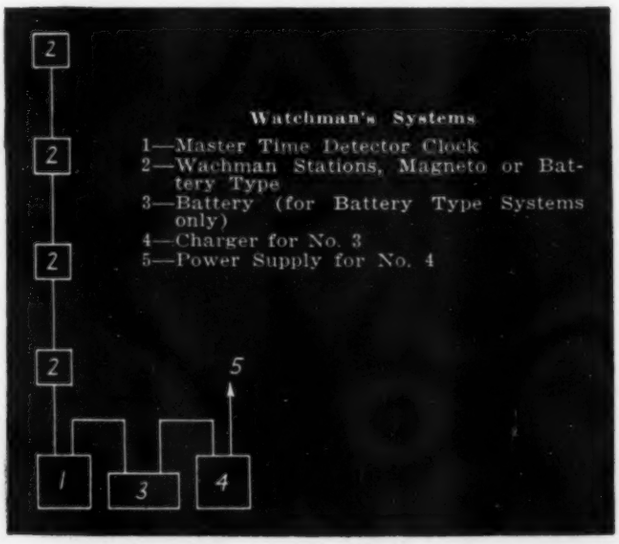
b. Magneto type systems

Similar to the battery type system with time detector and with or without clock, except that the individual stations are either equipped with a magneto generator or a plugging receptacle for the insertion of a portable magneto generator. When the watchman cranks a magneto at any one station, the time detector prints the record as explained before.

This system will accommodate from 4 to 100 stations. No current supply is needed except for a synchronous clock, when installed with the time detector. These systems can also be provided with an annunciator to give the watchman a possibility to check if all stations have been visited.

c. A leased wire supervisor system

Usually furnished under lease to provide a record of watchman rounds at central headquarters. Wiring connections are provided to the watchman stations from a central panelboard, electrically connected to a remote


Watchman's Systems
1—Master Time Detector Clock
2—Wachman Stations, Magneto or Battery Type
3—Battery (for Battery Type Systems only)
4—Charger for No. 3
5—Power Supply for No. 4

EXAMPLE 30—*Principal elements of watchman's system.*

supervisory office. On large systems, a combination of keys is used which requires only every tenth station on the watchman's route to be electrically connected. Except for large systems the current supply is provided over the outgoing leased wires.

2. *Specifications*

In specifying this system, major items will be: time detector, watchman's stations, plugging outlets for portable magneto stations, clock and visual indicator battery and battery charger.

N. ELECTRONIC COMMUNICATING SYSTEMS

1. *Selection*

An electronic communicating system consists fundamentally of one or more master stations containing an amplifier, speaker-microphone, switching system and a number of remote stations containing speakers. With this system, it is possible to call and talk from any master station to any or all remote stations, or to any or all master stations. No conversation is possible between two or more remote stations.

One master station is usually sufficient for from four to six remote stations. Systems where a large number of remote stations are to be called from one master station require additional amplifiers. Systems where calling is desired from any one station to any other station employ master stations only.

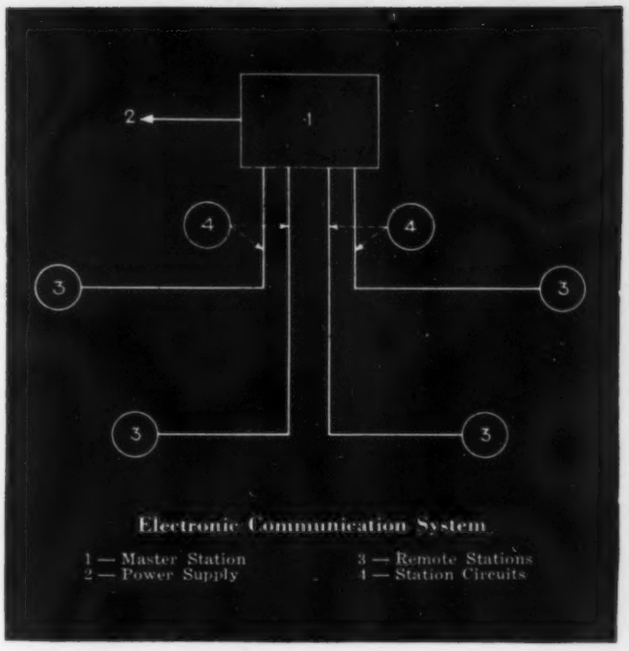
There are two systems of wiring possible for an electronic communicating system—

a. Carrier System

Utilizes the light or power circuit as carriers for high frequency current used for inter-communication. But this system is not commonly used because of power line noise.

b. Wired system.

Two conductors are installed from each set to each other set. Usually cables containing the required number of pairs are used for this purpose. The wired system has the advantage of privacy since no other tenant in the same building is able to cut in on a conversation.



EXAMPLE *31—Principal element of electronic communicating systems.*

In most electronic communicating systems all stations can listen to a conversation between two stations. If strict privacy is required the number of wires needed becomes very large and the number of stations is limited.

2. *Specifications*

In specifying this system major items will be: master stations, remote stations, multi-conductor cables and splicing boxes.

How to Specify the Large Job

A. GENERAL CONDITIONS

Use the American Institute of Architects standard form to cover general conditions. This form is sold by stationery stores in larger cities. It lists 44 articles that can be used as written. It saves a great deal of time and gives a uniform set of rules and conditions for each job.

But because the A.I.A. forms are written to cover all trades the following specific conditions should be added. See also section on "How to Specify the Apartment House," page 42.

1. *Codes, Permits and Inspection*

State that the installation shall be in accordance with the local electrical code or ordinance, the N.E.C. and the regulations of the power company. The contractor shall procure the necessary permit and after completion of the work will furnish a certificate of final inspection.

2. *Standards for Material and Workmanship*

All materials shall be new and conform with the standards of the Underwriters' Laboratories, Inc., wherever such standards have been established, and shall fulfill the normal requirements for satisfactory workmanship.

3. *Guarantee*

Guarantee that the electrical system will be left in proper working order and all defects developed within one year—except for normal wear and tear—will be made good.

4. *Temporary Light and Power*

Where it is necessary to install a wiring system for temporary light and power, cover it in the specification. State that this part of the work shall be estimated at a net field cost of labor and material, plus a certain percentage to be named in the specifications.

Where it is not possible to prepare a plan for the entire temporary wiring system, showing location of lights, power apparatus, service entrance, load centers and possibly a riser diagram, stipulate that this temporary work will be done as directed by the person or persons having authority.

5. *Painting and Redecorating*

Define what finish shall be applied to iron work and boxes which are not protected against corrosion. Normally two coats of asphaltum paint inside and out is satisfactory. Also state who will carry the cost of replastering or repainting, where parts of the building are unavoidably damaged by the execution of the electrical work.

6. *Scope of the Specifications*

List here each system to be included in the electrical contract, such as wiring for light, power, signaling systems. Also stipulate which parts of the contract call for furnishing labor and material or furnishing labor only.

B. SERVICE AND DISTRIBUTION EQUIPMENT

1. *Type of Service*

Obtain information as to the type and location of service to be supplied by the local power company. State the voltage, number of phases and number of wires for the service.

2. *Service Entrance Conductors*

Describe the approximate point of service entrance, whether the service will be overhead or underground. If above ground, state the height of termination and the type of material used — conduit, electrical metallic tubing, service entrance cable. If underground, state whether the service entrance conductors will run from a pole or be connected to underground mains, and define the type of material to be used—lead cable in raceway, armored or unarmored underground cable laid directly into the ground.

In all cases specify the number, size and type of insulation of the service entrance conductors for light as well as for power.

3. *Service Equipment*

For light and power and emergency power supply, where used, state the location, ampere rating and type of the service equipment—switch and fuses or circuit breakers. Type of equipment and provisions for mounting and metering should be in accordance with the service requirements of the local power company.

4. *Transformer Stations*

Provide detailed drawings wherever a transformer station is to be installed approved by the local power company. Prepare a schedule of the equipment and the materials to be used. State that the installation will be in accordance with these drawings and with this schedule and subject to final approval by the power company.

5. *Feeder and Power Distribution Centers*

Whether feeder distribution centers are dead front panelboards, dead front switchboards and assemblies of enclosed switches, or circuit breakers, the specification shall include—

Location
Number, size and capacity of the mains.
Number, size and capacity of the branches and the type of protective devices.
Provisions for increasing the capacity of the initially installed branches.
Provisions for future additions of branches—number and type of future control devices.
Equipment of the mains—lugs only, fuses only, switch, fusible switches or circuit breakers.

If panelboards are used describe the type of mounting—flush or surface—and other features of the construction—latch or lock. Give manufacturer's name and catalog number.

Where switchboards are installed, cover construction details—method of mounting and bracing, number, size and location of doors, location of the busbars—top or bottom, type and manufacturer's name. Where an assembly of enclosed switches or circuit breakers is used, give data on enclosure of mains and taps—auxiliary gutters or metal raceways—construction, finish and method of mounting the frame.

6. *Power and Heating Panelboards*

Give numbers assigned to each panelboard, the location, number and size of branches, the number of poles and the number and size of mains or buses. State the voltage and phases, and type of protective devices for the branches—fuses, circuit breakers—and the equipment of the mains—lugs, fuses, switches, fusible switches or circuit breakers. Also define the method of mounting—flush or surface—and the type of the panelboards and manufacturer's name. Describe provisions for future additions. See paragraph 5. "Feeder and power distribution centers" on page 56 for further details.

Sample—Power and Heating Panelboard Schedule

Panel No.	Location	No. and Size Branches	No. and Size Buses
PA	Basement	2- 60 amp.-3p. 4-100 amp.-3p.	3-300 amp.
PB	1st floor	6-100 amp.-3p.	3-400 amp.

7. *Lighting Panelboards*

Prepare a lighting panelboard schedule, giving the number assigned each panelboard, the location, number and capacity of the branch circuits and the capacity of the mains. State the voltage and phases—115-230 volts 3-wire or 120-208 volts, 3-phase 4-wire; the type of protective devices for the branches—fuses, fuses and switches or circuit breakers; and the equipment of the mains—lugs, fuses, switches, switch and fuse, or circuit breaker that will be installed.

Define the method of mounting—flush or surface—the type of the panel board and the manufacturer's name. Describe provisions for future additions.

Sample—Lighting Panelboard Schedule

Panel No.	Location	15-Amp. Circuits	Heavy-Duty Lamp Circuits 25-Amp.	Heavy-Duty Lamp Circuits 35-Amp.	Capacity Mains Amps.
LB	Basement	8	..	..	60
L1	1st Floor	6	10	4	200
L2	2nd Floor	8	6	2	200
L3	3rd Floor	8	6	2	200
L4	4th Floor	10	6	..	200
LW	1st Floor	10	..	..	100

Sample—Lighting Feeder Schedule

Feeder No.	From	To Panels	Panel Location	Conductors No.	Conductors Size	Conduit Size
1	Serv. Head	Serv. Switch	Basement	2	500,000 cir mils	3 in.
	Serv. Switch	Dist. Center		1	No. 4/0	
2	Dist. Center	LB	Basement	3	No. 6	1½ in.
3	Dist. Center	L1, L2	1st Fl., 2nd Fl.	2	No. 4/0	2½ in.
				1	No. 3/0	
4	Dist. Center	L3, L4	3rd Fl., 4th Fl.	3	No. 3/0	2 in.
5	Dist. Center	LW	1st Fl.	3	No. 4	1½ in.
Spare	Dist. Center	L1	1st Fl.	.1	Empty Conduit	2 in.
Spare	Dist. Center	L3	3rd Fl.	11	Empty Conduit	1½ in.

C. INSTALLATION: FEEDERS, CIRCUITS, OUTLETS

1. *Feeders*

Prepare a feeder schedule and a riser diagram where more than three or four feeders will be installed. State feeder number, the starting point and termination of the feeder, the location of the panels where the feeder terminates, the number and size of conductors and where necessary, the raceway size. Since different methods might be used in wiring for power, light and signaling, define the method to be employed for each division of the entire system.

2. *Branch Circuits and Outlets*

State the size of conductors to be installed in branch circuits and refer to the number of outlets per circuit, special circuits and larger conductors where indicated on the plans.

Indicate the location of the outlets on the plans. State that, except where otherwise shown or specified, wall brackets and convenience outlet switches shall be mounted at a certain height above the floor.

Where large, heavy fixtures are to be hung, describe the provision to be made in the ceiling outlets for the support of these fixtures.

Define the wall switches as S.P. tumbler switches, unless otherwise indicated, to control the outlets as shown on the plans.

Specify convenience outlets as 2-prong duplex, 15 amp., 125 volts, unless otherwise indicated and whether plugs will be furnished.

State that all splices in the outlet boxes shall be made electrically and mechanically secure and provided with insulation equal to that on the conductors. The length of the free conductors in each outlet box to be specified as at least 8-in.

D. INSTALLATION AND FURNISHING OF MOTORS, CONTROLLERS, HEATING EQUIP.

1. *Motors and Control—General*

Prepare a motor schedule listing assigned number, location, horsepower rating, speed, type of motor, type of machine driven and type of controller. State if motors and controls will be furnished and installed complete, or be furnished by others but installed under this contract, or if they will be furnished and installed by others, so that only the wiring to the motor location comes under this contract.

2. *Motors*

Classify voltage and phase requirements of all motors, grouping single phase, . . . volts . . . 2-phase . . . volts . . . 3-phase, . . . volts . . . direct current . . . volts. If more than the bare motor is furnished under the contract, prepare a detailed specification for each motor covering special equipment—sliding rails, tension adjusting base, belts, pulleys, chain drive, gear drive, couplings for direct connection.

3. *Control Equipment*

State that each motor rated 1/6 hp. or over shall be equipped with a controller, that overcurrent devices in the controller shall open all leads to the motor, or three leads for 2-phase motors. Describe all controllers by manufacturer's name and catalog number and for special control equipment used for multi-speed motors, elevators and special applications, detailed specification of the manufacturer should be a part of the specification. Define where and how the control units shall be mounted.

Sample—Motor and Controller Schedule

Motor No.	Hp.	Speed RPM	Type	Type of Controller	Machine Driven	Location
1	40	600	Wound rotor	F	Ref. compressor	Bsmt.
2	½	1200	Sq. cage	A	D.W. circ. pump	Bsmt.
3	3	1800	Sq. cage	B	Vac. pump	Bsmt.
4	5	1800	Sq. cage	B	Air compressor	Bsmt.
5	7½	1200	Sq. cage	C	Brine pump	Bsmt.
6	10	1200	Wound rotor	E	Pulverizer	1st Fl.
13	7½	1200	Sq. cage	D	Conveyor	2d Fl.
14	15	....	Special	Special	Frt. elevator	Pent

4. *Disconnecting Means*

State that where required by the Code, manually operatable disconnecting means shall be provided for each motor or group of motors driving several parts of a single machine. Switches and circuit breakers used for this purpose shall be mounted in a metal enclosure, externally operable and immediately adjacent to the motor or in the same enclosure with the motor starter. If a switch is used for this purpose, it shall be non-fusible, but a fusible switch at the distribution center may serve as disconnecting means, provided it is located within sight of the motor or is so arranged it can be locked in the "off" position.

5. *Methods of Wiring to Motors*

Prepare wiring diagrams showing the method to be used in wiring to each motor, the size of all feeders, subfeeders, taps and branch circuits and the size of all raceways. State that the wiring for the motors shall be installed in accordance with these diagrams, being any one of the five motor feeder diagrams on pages 57, 58. Define the permissible voltage drop for each motor feeder layout.

GOOD WORKMANSHIP *is assured, when conduit routings are carefully planned and specifications provide the right type and quality of materials.*

6. *Wiring for Electrically Heated Equipment*

Where electrically heated appliances constitute only a small portion of the total load, the neecssary power can usually be supplied through the power or lighting feeders. Where the heating load is large enough to become a factor, specify separate feeders. Prepare a heater schedule assigning a number to each heating device, giving the wattage, type of units, type of control, machine to be equipped and location of the heaters. Include large portable heating units in this schedule.

7. *Specifications for Wiring Materials and Lighting Equipment*

Describe all material used in the installation to bring out specific construction details and the quality of the job, so that inferior work and materials can not be substituted.

Where standard materials are used identify them by the manufacturer's catalog number.

Give a detailed description of special materials such as large switchboards. Consult the manufacturer and follow his specifications where complicated apparatus or systems are involved, such as—

Stage switchboards and dimmer banks
Hospital signaling systems
Intercommunicating telephones
Fire alarms
Special switchboards and panelboards
Theater and auditorium lighting
Clock and program systems for schools

The following check list of materials covers the commonly used items in most installations. The specifications should describe any of these materials or devices that are to be used in the installation, also the other special or less common items that will be required for a job. These should appear in the specification under most appropriate sections. For instance, a special switch should be listed under standard switches, and special receptacles follow standard receptacles.

a. Raceways

Rigid steel conduit—enameled—galvanized
Corrosion resistive, non-ferrous alloy rigid conduit
Oval conduit
Flexible metallic conduit
Electrical metallic tubing
Underfloor raceway—metallic—non-metallic
Surface metal raceways

b. Wireways, Busways, Bare Busbars and Risers

c. Wires and Cables

Rubber covered wires—several grades available
Varnished cambric insulated wires
Asbestos covered and braided wires—several grades for dry or wet locations
Lead covered wires
Special insulation—several types available
Armored cable
Non-metallic sheathed cable
Covered neutral cable
Service entrance cables—several grades available
Underground cables—several grades available

d. Outlet and Switch Boxes

Sheet steel—enameled—galvanized
Cast iron—enameled—galvanized—cadmium plated
Non-corrosive metal or alloy
Porcelain
Explosion proof
Vapor proof
Weather proof

e. Multi-Outlet Assemblies

Convenience outlet assemblies
Lamp receptacle assemblies

f. Receptacles

Wall
Outlet box lamp, with or without switching
Range
Watertight, weather proof and floor
Heavy duty
Locking type
Explosion proof
Three and four wire
Radio, fanhanger and clock

g. Lights

Night—aisle—pilot

h. Switches

Flush tumbler wall—standard, heavy duty
Surface type tumbler
Rotary
Industrial—tumbler, push, rotary
Outdôor
Ceiling and wall pull type
Door
Canopy
Mercury
Remote control
Preset time delay trip off wall

i. Plates

Brass
Glass
Composition—bakelite, textolite

j. Control and Protective Devices

Externally operated switches with thermal cutout or fuse protection. Cases to be enameled, galvanized, or cadmium plated.

Circuit breakers—panel mounted, box mounted
Time switches—clock operated
Remote control switches—electrically held, mechanically held, single throw, double throw, completely enclosed, panel or switch board mounted.

k. Fuses

Plug
Cartridge—non-renewable, renewable

l. Signal System Devices

For check list on signal system devices see "Signaling and Communication" page 60, 67.

m. Lighting Equipment

State if lamps have to be furnished with the contract or not. Designate each type of fixture by a letter or number and describe this type in a separate paragraph giving manufacturer's name and catalog number.

Where fixtures will be of special construction a drawing of the fixture should be a part of the specification.

Have drawings complete in detail and list number and size of lamp-holders, key, keyless or pull chain; lamp wattage; description of reflector, material, size; tubing, wall thickness; size of chain links; material and thickness of the canopies and bodies.

Prepare a lighting equipment schedule designating type, number required, number of lamps and wattage per fixture, overall length, finish, location, and special information.

Sample Schedule of Lighting Equipment

Type	Number Required	Lamps No.	Lamps Wattage	Length Overall	Finish	Location
A	24	1	500	48 in.	Old Brass	1st Fl. sales room
B	24	1	300	36 in.	Old Brass	2d Fl. sales room

Submitting the Proposal

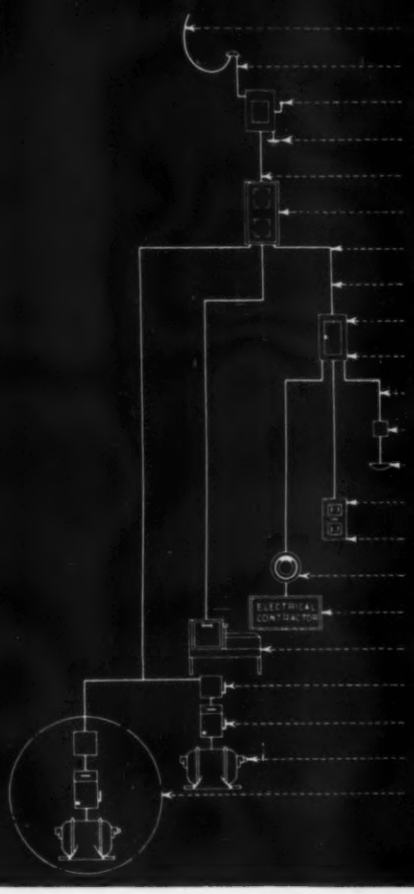
Where specifications and drawings are complete it is not necessary to submit a detailed proposal. A letter, referring to the work as outlined in the drawings and specifications, and quoting a price for the entire job will be sufficient. Use Form E on the back cover of "The Standard Documents of the American Institute for Architects."

In cases where it is left to the contractor to select the proper materials, wiring method, and wiring system, however, the proposal should contain enough information to stand comparison with other proposals, not only as to price but also in its assurance of quality and workmanship. Prepare the proposal so that it shows why materials of extra high grade are used and why the price might be higher than the one submitted by a competitor, who does not fully satisfy the requirements of the installation.

BUS CONSTRUCTION *answers many distribution needs, when adequately planned and specified at the start on the basis of long-term demands.*

THE CODE AT A GLANCE

A CROSS-INDEX CODE REFERENCE of twenty-two commonly encountered topics, keyed to a typical schematic system of interior wiring. For more special topics see Table of Contents Cross References.



	1937 CODE	1935 CODE
Outside Wiring	Art. 730	Art. 3
Service Entrance	" 230	" 4
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Switchboards	" 384	" 13
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Conductors	" 300; Ch.9 and 10	" 6
Panelboards	" 384	" 13
Overcurrent Protection	" 240; Ch.9	" 8
Branch Circuits	" 210	" 20
Outlets & Junction Boxes	" 370; Ch.10	" 5 and 7
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Hazardous Locations	" 500	" 32

A GUIDE TO CODE TABLES

IN planning a wiring system, frequent reference must be made to various tables in the National Electrical Code. Because of the Code's wide distribution, this Engineering Data is available to all and should be kept handy for reference. We list below important tables, examples and diagrams that are useful in planning an electrical system, and the pages on which this data appears in the 1937 edition of the Code—

TABLE 1—Allowable carrying capacity of conductors—Page 262

TABLE 2—Number of conductors in conduit or tubing—Page 264

TABLE 3—More than nine conductors in conduit or tubing—Page 265

TABLE 4—Number of lead-covered conductors in conduit or tubing—Page 266

TABLE 5—Percent area of conduit or tubing—Page 267

TABLE 6—Dimensions of rubber-covered conductors—Page 268

TABLE 7—Dimensions of lead-covered conductors—Page 268

TABLE 8—Dimensions of conduit or tubing—Page 269

TABLE 9—Three-conductor convertible system for conduit or tubing—Page 269

TABLE 10—Motor wiring — conductor sizes and overcurrent protection — Page 270

TABLE 11—Full load current, d.c. motors—Page 274

TABLE 12—Full load current, single phase a.c. motors—Page 274

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TABLE 15—Rating or setting of motor protective devices—Page 277

TABLE 16—Number of overcurrent units for protection of circuits—Page 278

TABLE 17—Computation of lighting load—Page 280

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EXAMPLES—For calculating feeders — Page 294

EXAMPLES—For calculating neutral feeder—Page 297

EXAMPLES—For calculating motor circuits—Page 297

SYMBOLS FOR WIRING PLANS

GENERAL OUTLETS

	CEILING	WALL
Outlet	○	○
Capped Outlet	(C)	(C)
Drop Cord	(D)	
Electrical Outlet—for use when confused with columns, plumbing symbols, etc.	(E)	(E)
Fan Outlet	(F)	(F)
Junction Box	(J)	(J)
Lamp Holder	(L)	(L)
Lamp Holder with Pull Switch	$(L)_{PS}$	$(L)_{PS}$
Pull Switch	(S)	(S)
Outlet for Vapor Discharge Lamp	(V)	(V)
Exit Light Outlet	(X)	(X)
Clock Outlet (Lighting Voltage)	◷	◷

CONVENIENCE OUTLETS

Duplex Convenience Outlet

Convenience Outlet other than Duplex. 1=Single, 3=Triplex, etc. $_{1,3}$

Weatherproof Convenience Outlet. $_{WP}$

Range Outlet $_{R}$

Switch and Convenience Outlet $\$$

Radio and Convenience Outlet R

Special Purpose Outlet (describe in specifications)

Floor Outlet

SWITCH OUTLETS

Single Pole Switch $\$$

Double Pole Switch $\$_2$

Three Way Switch $\$_3$

Four Way Switch $\$_4$

Automatic Door Switch $\$_D$

Electrolier Switch $\$_E$

Key Operated Switch $\$_K$

Switch and Pilot Lamp $\$_P$

Circuit Breaker $\$_{CB}$

Weatherproof Circuit Breaker $\$_{WCB}$

Momentary Contact Switch $\$_{MC}$

Remote Control Switch $\$_{RC}$

Weatherproof Switch $\$_{WP}$

SPECIAL OUTLETS

Any standard symbol with the addition of a subscript letter designates some special variation of standard equipment. ○ a,b,c-etc. ⊖ a,b,c-etc.

List the key of symbols on each drawing and describe in specifications. $\$$ a,b,c-etc.

PANELS, CIRCUITS & MISCELLANEOUS

Lighting Panel

Power Panel

Branch 2-Wire Circuit — Ceiling or Wall

Branch 2-Wire Circuit—Floor

Indicate a greater number of wires: -/// (3 wires), -//// (4 wires), etc.

Feeders. Use heavy lines and designate by number from Feeder Schedule

Underfloor Duct & Junction Box — Triple System. For double or single systems eliminate one or two lines

Generator (G)

Motor. (M)

Instrument (I)

Transformer (T)

Controller

Isolating Switch

AUXILIARY SYSTEMS

Push Button

Buzzer

Bell

Annunciator

Telephone

Telephone Switchboard

Clock (Low Voltage)

Electric Door Opener D

Fire Alarm Bell F

Fire Alarm Station F

City Fire Alarm Station

Fire Alarm Central Station FA

Automatic Fire Alarm Device FS

Watchman's Station W

Watchman's Central Station W

Horn H

Nurse's Signal Plug N

Maid's Signal Plug M

Radio Outlet R

Signal Central Station SC

Interconnection Box

Battery

Auxiliary System 2-Wire Circuit

For a greater number of wires designate with numerals — 12-No. 18W-¾"-C., or by listing in schedule.

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YOU WILL PLEASE BUILDING OWNERS AND INSPECTORS WITH G-E WIRING MATERIALS

On some wiring jobs you write the specifications. On others you bid on specifications furnished you. In both cases there are two men you must consider—the building owner and the electrical inspector. The building owner wants wiring that will provide current where he wants it for lighting, motors, appliances and other electrical equipment. The inspector cannot approve wiring unless it is properly installed and materials used which meet national and local safety standards.

General Electric Wiring Materials will help you. The line is complete. No makeshift wiring is necessary. There is always the right material for any wiring purpose. The quality of G-E materials is unquestioned. Code standards are far surpassed.

Therefore, building owners will be pleased with the neat workmanlike job you are able to do with G-E materials and with the lasting service they receive from the wiring. Inspectors also will be pleased with the workmanlike job and the quality of the materials.

Moreover, you will increase your reputation as a competent electrical contractor. And you will benefit further because G-E materials are made to be used together and can be installed easily and quickly. There will be no time wasted in service calls after the job is done. G-E materials give lasting service.

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FOR INFORMATION ON G-E WIRING MATERIALS FOR ALL TYPES OF BUILDINGS TURN PAGE

For further information about G-E Wiring Materials, see the G-E Merchandise Distributor nearest you or write to Section K-944, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

SEE THE G-E "HOUSE OF MAGIC" AT BOTH FAIRS

GENERAL ELECTRIC

YOU WILL PLEASE BUILDING OWNERS AND INSPECTORS WITH G-E WIRING MATERIALS

G-E SERVICE ENTRANCE MATERIALS PROVIDE WIDE CHOICE

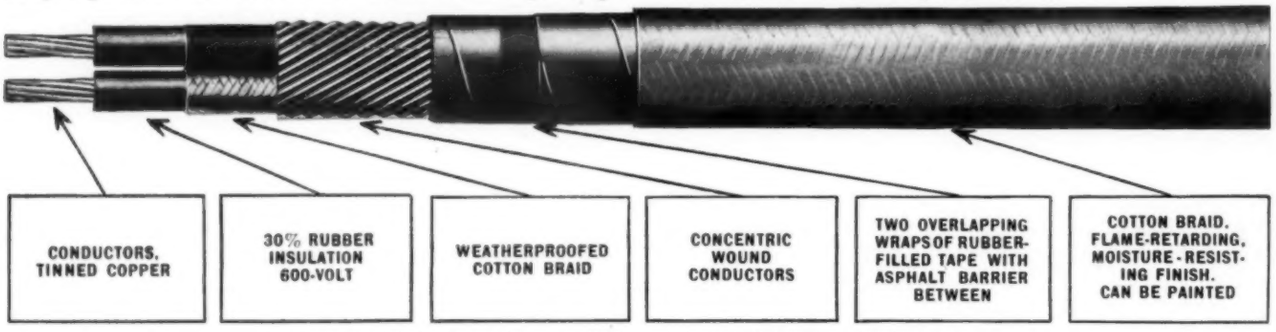
G-E ELECTRICAL METALLIC TUBING IS EASY TO USE

G-E WHITE GIVES PERMANENT PROTECTION

G-E WHITE RIGID CONDUIT is hot-dipped galvanized and Glyptal-coated inside and out. Special mild, rimmed steel is used to manufacture tubing for G-E Conduit. The result is an easy-bending, ductile raceway. Connections at all points are made with threaded fittings. G-E White resists heat, moisture, gas, acids. A complete line of fittings is available.

G-E BLACK RIGID CONDUIT is the same mild steel tubing coated inside and out with a corrosion-resistant, elastic black enamel which is baked on at a high temperature.

G-E ELECTRICAL METALLIC TUBING is light, easy to bend and requires no threading. Compression couplings and connectors are available for joining lengths of this tubing to each other and to outlet boxes. Approved by Underwriters' Laboratories for both concealed and exposed work.


CONDUCTORS, TINNED COPPER
30% RUBBER INSULATION 600-VOLT
WEATHERPROOFED COTTON BRAID
CONCENTRIC WOUND CONDUCTORS
TWO OVERLAPPING WRAPS OF RUBBER-FILLED TAPE WITH ASPHALT BARRIER BETWEEN
COTTON BRAID, FLAME-RETARDING, MOISTURE-RESISTING FINISH. CAN BE PAINTED

G-E SERVICE ENTRANCE CABLE—TYPE SE, STYLE U. OTHER G-E SERVICE ENTRANCE AND SERVICE DROP CABLES ARE AVAILABLE

G-E SERVICE ENTRANCE CABLES are available in different types and styles. These cables will meet all requirements and conditions. They are extremely flexible, afford maximum mechanical protection and are durable in all climates. G-E Service Entrance Connectors and Entrance Caps provide snug installations.

G-E LEADED CABLES HAVE A WIDE VARIETY OF USES INCLUDING SERVICE ENTRANCE

G-E 600-VOLT LEADED CABLE—For underground use in rigid conduit. It consists of solid and stranded conductors insulated with rubber and enclosed in a lead sheath for moisture protection.

G-E MOISTURE-RESISTING GRADE BUILDING WIRE PERMITS LOW-COST DEPENDABLE INSTALLATIONS

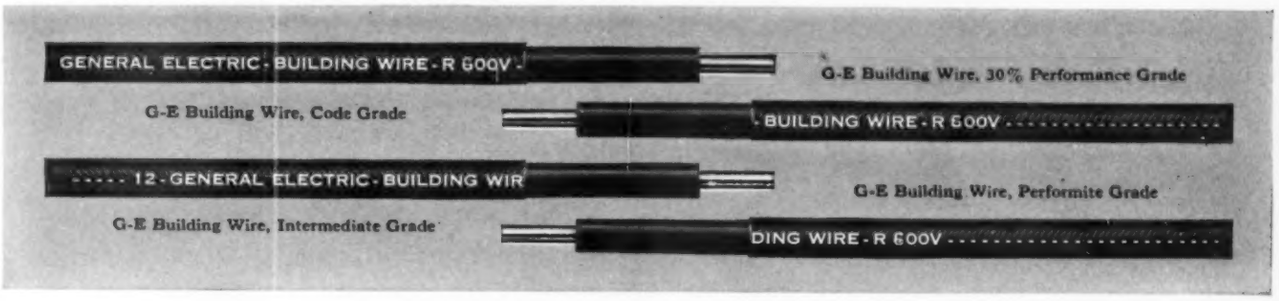
G-E MOISTURE-RESISTING GRADE BUILDING WIRE—Insulated with a moisture-resisting compound. This wire can be used in raceway systems in lieu of leaded cable where specified in Article 300, Section 3035, National Electrical Code.

For further information about G-E Wiring Materials, see the G-E Merchandise Distributor nearest you or write to Section K-944, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

GENERAL ELECTRIC

YOU WILL PLEASE BUILDING OWNERS AND INSPECTORS WITH G-E WIRING MATERIALS

G-E WIRES AND CABLES PROVIDE CONDUCTORS FOR ANY TYPE OF WIRING SYSTEM


GENERAL ELECTRIC - BUILDING WIRE - R 600V
G-E Building Wire, 30% Performance Grade
G-E Building Wire, Code Grade
BUILDING WIRE - R 600V
12 - GENERAL ELECTRIC - BUILDING WIR
G-E Building Wire, Performite Grade
G-E Building Wire, Intermediate Grade
DING WIRE - R 600V

G-E RUBBER-INSULATED WIRE AND CABLE is made in three standard commercial grades. A fourth grade, Performite, meets special Federal building requirements. All four grades have close fitting braids which do not fray or slip back and have a flame-retarding and moisture-resisting finish. All are marked for quick identification of size, type and voltage. Smooth, generous coatings of paraffin help to make wire pulling easy.

G-E TYPE S CORD

G-E TYPE S "60%" LEAD CURED ALL-RUBBER CORD provides dependable, uninterrupted service for heavy-duty electrical equipment in places where the cord is required to operate under severe conditions. It has given entire satisfaction in thousands of factories, docks, railroad terminals, mines, etc. Approved by the Underwriters' Laboratories.

G-E BLUE-BUSHED BX—EASIER TO USE—HAS MORE DIELECTRIC STRENGTH

G-E "BLUE-BUSHED BX" ARMORED CABLE has a new S-shaped paper wrap which is easier to remove than the crumpled paper commonly used on ordinary armored cable. This wrap provides additional protection for the conductors at the termination of the steel armor. Bushings are inserted between the paper and the armor. The S-shaped paper separates the conductors from each other providing additional dielectric strength. A complete line of fittings is available.

G-E BRAIDX NON-METALLIC SHEATHED CABLE—FOR NEW AND OLD WORK

G-E BRAIDX NON-METALLIC SHEATHED CABLE consists of two or more rubber insulated conductors in a special protective covering having high resistance to mechanical injury. When required, General Electric BraidX will be supplied containing an additional non-insulated copper conductor for grounding purposes. Can be used for new or old work. Necessary fittings are available.

For further information about G-E Wiring Materials, see the G-E Merchandise Distributor nearest you or write to Section K-944, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

GENERAL ELECTRIC

YOU WILL PLEASE BUILDING OWNERS AND INSPECTORS WITH G-E WIRING MATERIALS

GE-4

G-E CONDUITS AND RACEWAYS AFFORD COMPLETE PROTECTION

The line of G-E raceways includes G-E White hot-dipped galvanized conduit, G-E Black enamelled conduit, G-E Electrical Metallic Tubing, G-E Galvanized Flexible Metal conduit and G-E underfloor Fiberduct.

G-E CONDUITS and RACEWAYS provide a wide choice and include raceways for all locations and all purposes.

G-E WHITE RIGID CONDUIT is the accepted standard raceway for use where conductors are buried in concrete or masonry and for exposed wiring where maximum mechanical protection is required. G-E White is hot-dipped galvanized and Glyptal-coated inside and out.

G-E BLACK RIGID CONDUIT is made of the same heavy-wall steel tubing as G-E White but it is finished with an enamel coating inside and out.

G-E ELECTRICAL METALLIC TUBING is a thin-walled electro-galvanized steel raceway which performs the same function as G-E rigid conduit but with a lesser degree of protection.

G-E GALVANIZED FLEXIBLE METAL CONDUIT is ideal for use where construction requires a flexible raceway system or for connecting adjustable equipment to a rigid system. It is widely used for sign wiring, motor leads and temporary wiring.

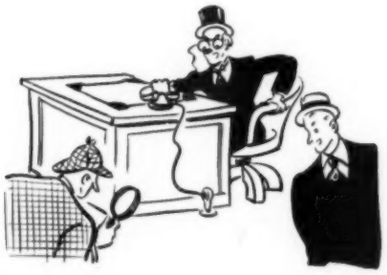
G-E FIBERDUCT UNDERFLOOR RACEWAY SYSTEMS will carry light, power, signal and telephone wires to any part of the floor area of a building. G-E Fiberduct systems provide electrical outlets for all present and future needs. Outlets may be changed or added at any time. Unused outlets may be neatly capped until needed again. G-E Fiberduct is a flat oval tubing of impregnated fiber that resists corrosive influences encountered in actual service. It forms a system of non-corrodible raceways in concrete floors. Fiberduct is 1½-in. or 3¾-in. O.D.

G-E Fiberduct multiple assembly before final concrete is poured. Outlet inserts to be added when and where needed later.

Telephone Outlet

G-E Fiberduct installation. Note junction box and factory-set Prelokaylets (outlets).

Lighting Outlet



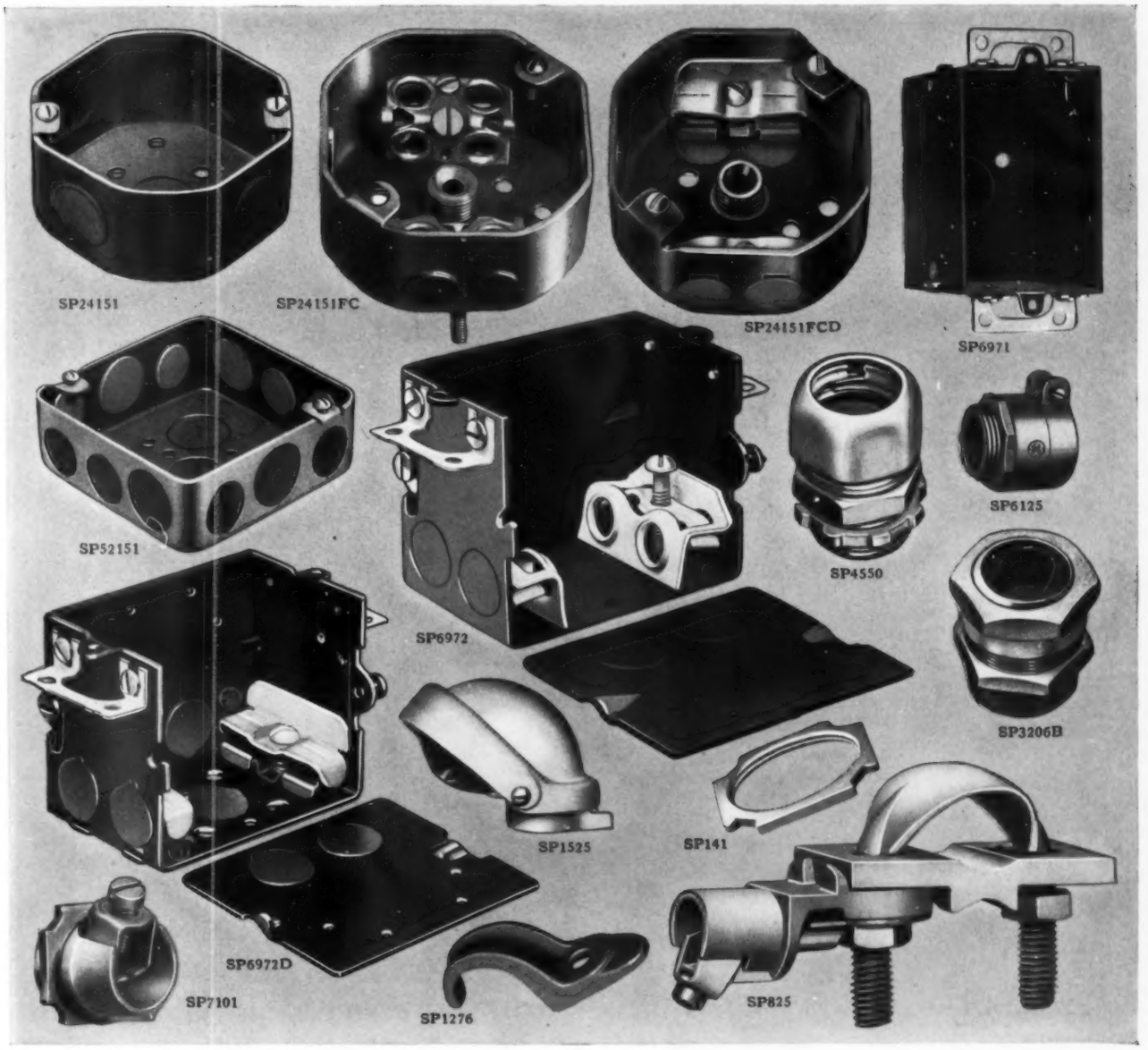
For further information about G-E Wiring Materials, see the G-E Merchandise Distributor nearest you or write to Section K-944, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

GENERAL ELECTRIC

YOU WILL PLEASE BUILDING OWNERS AND INSPECTORS WITH G-E WIRING MATERIALS

GE-5

THE LINE OF G-E BOXES AND FITTINGS IS COMPLETE FOR ALL PURPOSES



THESE ARE BUT A FEW OF THE MANY G-E BOXES AND FITTINGS AVAILABLE

GENERAL ELECTRIC BOXES AND FITTINGS reduce installation time. There are Outlet and Utility boxes for every type of installation. A wide assortment of covers is available. There are also standard General Electric Fittings for every type of raceway. These boxes and fittings meet every requirement for commercial, industrial and residential wiring.

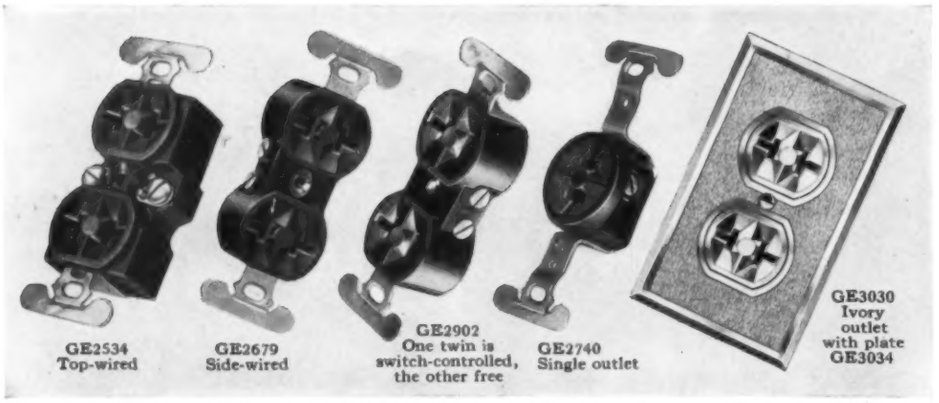
For further information about G-E Wiring Materials, see the G-E Merchandise Distributor nearest you or write to Section K-944, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

GENERAL ELECTRIC

YOU WILL PLEASE BUILDING OWNERS AND INSPECTORS WITH G-E WIRING MATERIALS

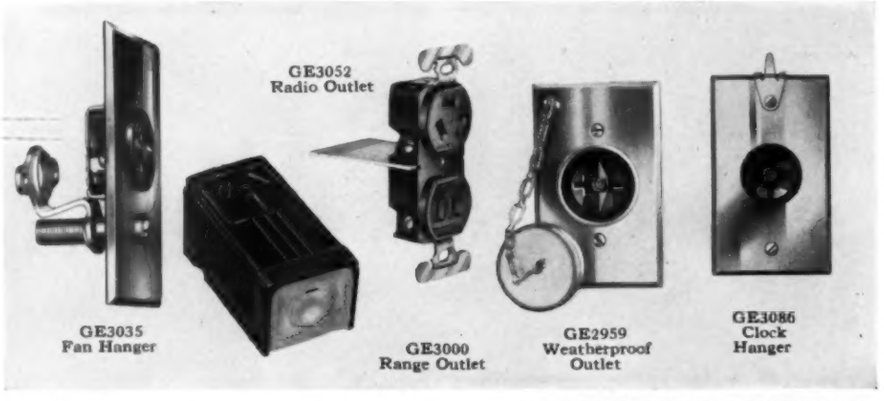
GE-6

G-E WIRING DEVICES ARE EFFICIENT THE LINE IS COMPLETE

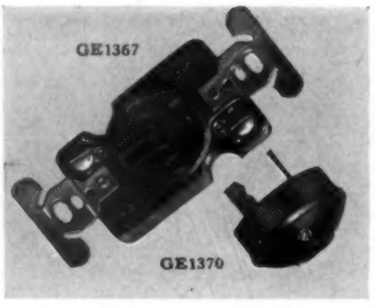


HERE ARE A FEW OF THE MORE COMMONLY USED G-E CONVENIENCE OUTLETS. THERE ARE MANY OTHERS INCLUDING SOME SPECIAL-PURPOSE OUTLETS

G-E CONVENIENCE OUTLETS are made of Textolite with smooth faces so designed that the prongs of a plug slip easily into the proper slots. They have large binding screws and wide mounting ears for easy installation.



G-E LAMPHOLDERS are available with porcelain, brass or Textolite shells rated at 250 or 660 watts, 250 volts. G-E brass lampholders are made in two types—fluted-catch and threaded-catch. G-E Textolite Lamp holders have all moving parts sealed for complete protection. A new line of G-E White Textolite Lampholders for outlet-box mounting has been recently introduced. These new Textolite Lampholders supersede a former similar line of porcelain lampholders.



G-E HEAVY-DUTY POLARITY PLUGS AND RECEPTACLES. There is a wide selection of receptacles and plugs to choose from in the G-E heavy-duty receptacle line. These devices are designed to maintain the polarity of a circuit. They can be used for connecting appliances, motors and devices on heavy-duty circuits. Furnished double-pole, triple-pole and four-pole.

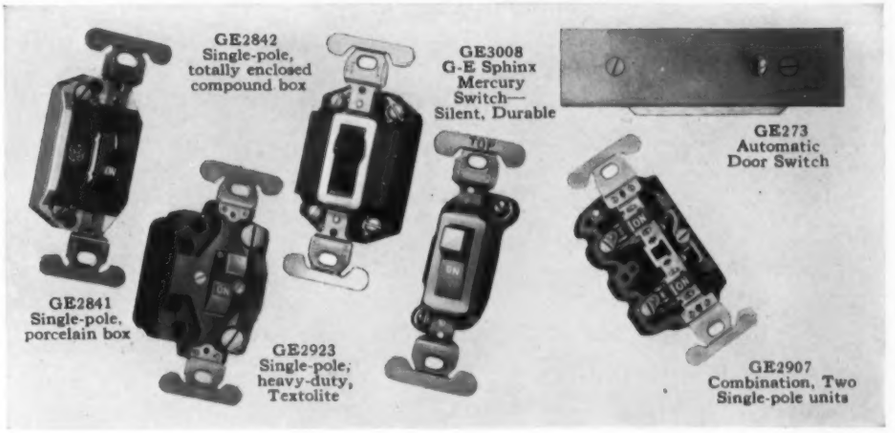
G-E SPECIAL OUTLETS. Shown here are some of the special G-E outlets available which are designed for specific purposes. The G-E Flush Electric Clock Hanger provides support and connections for an electric wall clock. The G-E Fan Hanger outlet serves a similar purpose for fans. The Weatherproof outlet, the Radio outlet and the Range outlet are designed for special service.

For further information about G-E Wiring Materials, see the G-E Merchandise Distributor nearest you or write to Section K-944, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

GENERAL ELECTRIC

YOU WILL PLEASE BUILDING OWNERS AND INSPECTORS WITH G-E WIRING MATERIALS

G-E SWITCHES—FOR HOMES, COMMERCIAL BUILDINGS AND FACTORIES



G-E TUMBLER SWITCHES are made in both surface- and flush-mounting styles. The surface-mounting styles of course are for use where appearance is not a factor. G-E Rotary Snap Switches and Push Button Switches are also available.

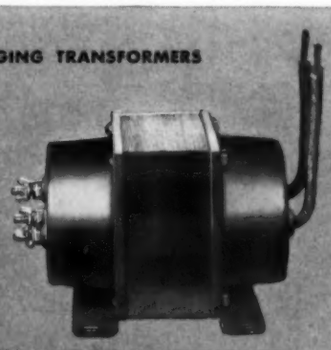
G-E FLUSH-MOUNTING TUMBLER SWITCHES are available in the following grades: porcelain box, composition box and Textolite box.

G-E SPHINX MERCURY SWITCHES are silent and durable. Cushioned action—no noise on make or break. Long life—no spring to break, no blades to hammer away. Arc is enclosed in glass-sealed button.

Other styles available include G-E Outdoor Switches, G-E Electrolier Switches, G-E Lock Switches, G-E Combination Switch Assemblies, etc.

G-E BELL RINGING TRANSFORMERS

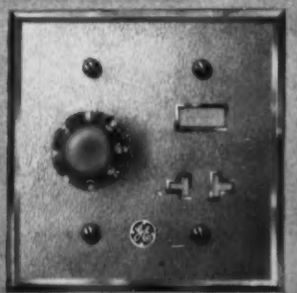
G-E Bell Ringing Transformers are available in residence and in heavy-duty types for 110-volt or 220-volt primary current. They can be installed at some convenient point to provide low-voltage current for bell, buzzer and annunciator circuits.



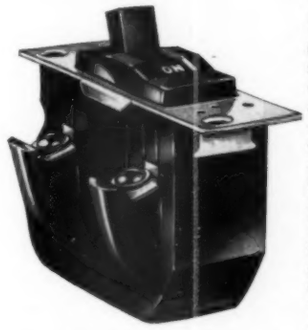
G-E HEAVY-DUTY BELL RINGING TRANSFORMER

G-E COMBINATION DEVICES

G-E Switch and Outlet combinations in one device are designed for convenience and space saving and to increase the effectiveness of circuit control. They are available in the following units: Switch and Convenience Outlet; Switch and Pilot Light; Switch, Pilot Light and Convenience Outlet.

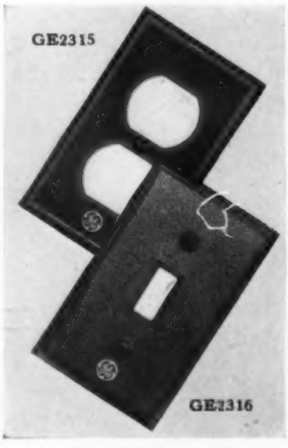


G-E COMBINATION SWITCH, CONVENIENCE OUTLET AND PILOT LIGHT



G-E Branch-circuit Circuit Breaker available in capacities of 15, 20, 25, 30 and 35 amperes—125 volts a.c. or d.c.

G-E BRANCH-CIRCUIT CIRCUIT BREAKERS serve both as master control switches and as a means of circuit protection. They are designed to provide homes with the same efficient protection and control in the manner used in many large buildings and industrial plants. They are also ideal for many commercial and industrial wiring purposes such as the control and protection of lighting circuits. They may be adapted for many special applications. They can be mounted at the most convenient location, singly or in gangs.



G-E TEXTOLITE PLATES. G-E standard flush plates for convenience outlets, switches, and floor outlets are made of brass, Textolite (black or brown) and ivory compound in a variety of forms and combinations to meet all possible requirements.

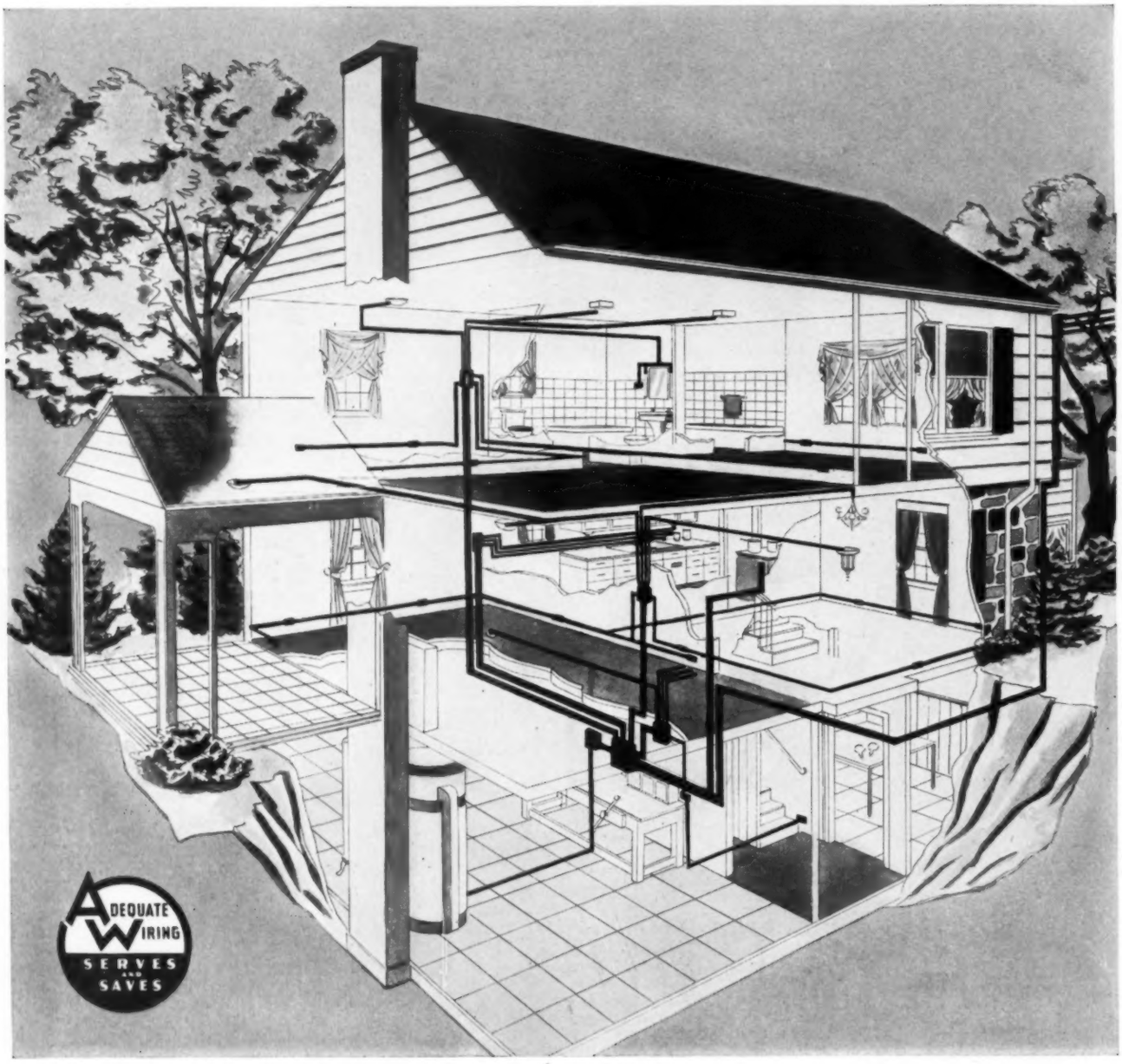
For further information about G-E Wiring Materials, see the G-E Merchandise Distributor nearest you or write to Section K-944, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

GENERAL ELECTRIC

YOU WILL PLEASE BUILDING OWNERS AND INSPECTORS WITH G-E WIRING MATERIALS

GE-8

G-E HOME WIRING MEETS TODAY'S NEED FOR EFFICIENT RESIDENTIAL WIRING



CUTAWAY VIEW OF HOME SHOWING HOW G-E HOME WIRING PROVIDES FOR MODERN NEEDS

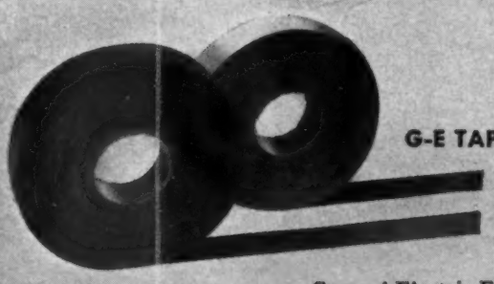
G-E HOME WIRING is designed to provide enough copper and outlets to serve all modern home appliances and modern lighting. It can be installed in many different ways. Each circuit of the system is independent with local control. Long circuit runs are avoided. Heavy risers terminate at conveniently located branch distribution units, from which final branch circuits are divided into separate runs. Economies are effected and the overloading of circuits is prevented. This method of wiring is not expensive in comparison with conventional wiring done adequately. Moreover, rewiring will be avoided.

For further information about G-E Wiring Materials, see the G-E Merchandise Distributor nearest you or write to Section K-944, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

GENERAL ELECTRIC

YOU WILL PLEASE BUILDING OWNERS AND INSPECTORS WITH G-E WIRING MATERIALS

G-E INSULATING MATERIALS HANDLE EASILY— PROVIDE LONG-LIFE INSTALLATIONS



G-E TAPES

General Electric Friction Tape won't dry up or ravel—it really *sticks*. G-E Rubber Tape can be moulded by the heat of the hand to form a water-tight insulated joint. G-E Varnished Cloth and Cotton Tapes likewise satisfy contractors and customers.

G-E VARNISHED CLOTH

G-E Varnished Cloths are extremely flexible, have high dielectric and tensile strength, and will endure. Available in drill and duck, silk, and other materials, in black or yellow colors.

G-E VARNISHES

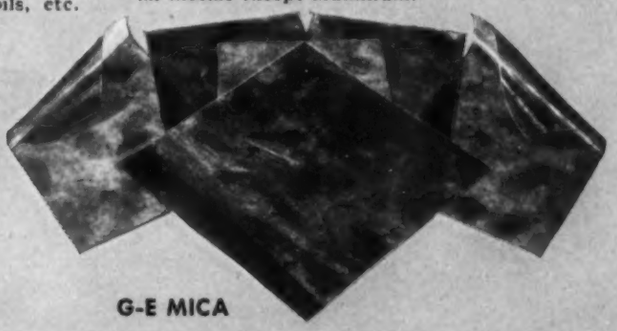
G-E No. 1676 Black Baking Varnish is a highly effective plastic baking varnish. G-E No. 152 Clear Air-drying or Baking Varnish is used extensively on commutator rings, transformer coils, etc.

G-E SOLDERS

G-E Core Solder saves you both time and money. It is rapid and will not spatter. G-E Core Solder is of the highest quality, economical, efficient and dependable. It will solder all metals except aluminum.

G-E GLYPTAL RED

G-E No. 1201 Glyptal Red is extensively used as a protective coating on the windings of electrical apparatus, on metallic surfaces, etc., and as a filler or sealer for joints to prevent leakage of gas, water, oil, and other materials.



G-E MICA

Available in segment, moulding, heater, and flexible plates. Also in tapes, composite insulations, tubing, and washers. Superior insulating properties are obtained by highly exacting production methods.

Electrical contractors throughout the country use and approve of G-E Insulating Materials. Contractors find them easy to handle and durable. These are the same materials that G. E. uses in the manufacture of its own products. A few of these materials are shown above. For information on the complete line of G-E Insulating Materials, write to the address below.

For further information about G-E Wiring Materials, see the G-E Merchandise Distributor nearest you or write to Section K-944, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

GENERAL ELECTRIC

YOU WILL PLEASE BUILDING OWNERS AND INSPECTORS WITH G-E WIRING MATERIALS

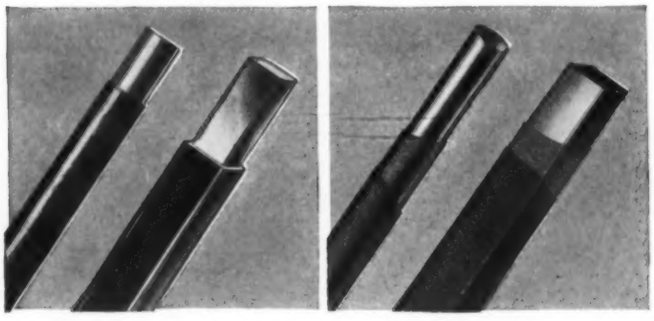
GE-10

USE DELTABESTON WIRE AND CABLE WHERE HEAT IS A PROBLEM

G-E Deltabeston purified felted-asbestos insulation resists heat, flame, oil, grease and corrosive vapors. Deltabeston Wires and Cables are made in a wide variety of types for industrial and commercial use where the wiring is subjected to high temperatures. Some of these types follow: Power Cable, Flexible Apparatus Cable, Boiler Room Wire, Electric Stove and Range Wire, Electric Range Cable, Fixture Wire, Magnet Wire, Motion Picture Machine Cable, Elevator Control Cable, Flexible Cords, Switchboard Wire, Appliance Lead Wire.

DELTABESTON BOILER ROOM WIRE

DELTABESTON BOILER ROOM WIRE. For 600-volt service. A.V.A. insulation. This wire is recommended for exposed or conduit wiring in boiler rooms where a heat- and flame-proof installation is required. Will give permanent, uninterrupted service under constant high temperature.



DELTABESTON AND "DELTAGLASS" MAGNET WIRE. Both are available in round, square and rectangular shapes. Deltabeston Magnet Wire is insulated with purified, felted asbestos. It has high dielectric strength. It is resistant to heat, moisture and acids. The insulation is tough, flexible. It won't crack when the wire is bent at sharp angles. "Deltaglass" Magnet Wire is available with one or two wraps of glass yarn, or with enamelled copper conductor covered with a single or double wrap of glass yarn. These glass wraps are bound together and to the conductor with special varnish. This varnish also seals the glass and furnishes a smooth, uniform, moisture-resistant surface. "Deltaglass" insulation is flexible, has high dielectric strength and can be furnished with lighter insulating wall, thereby improving the space factor.

USE G-E TUNGAR BATTERY CHARGERS AND COPPER-OXIDE RECTIFIERS IN LARGE BUILDINGS

MODEL 6RC75D1 COPPER-OXIDE BATTERY CHARGER—FOR FIRE-ALARM BATTERIES

Low-priced and extremely efficient copper-oxide rectifiers have been developed by General Electric to meet an ever-growing demand for dependable trickle chargers for fire-alarm batteries. Unusually economical in operation these trickle chargers keep fire-alarm batteries fully charged at all times.

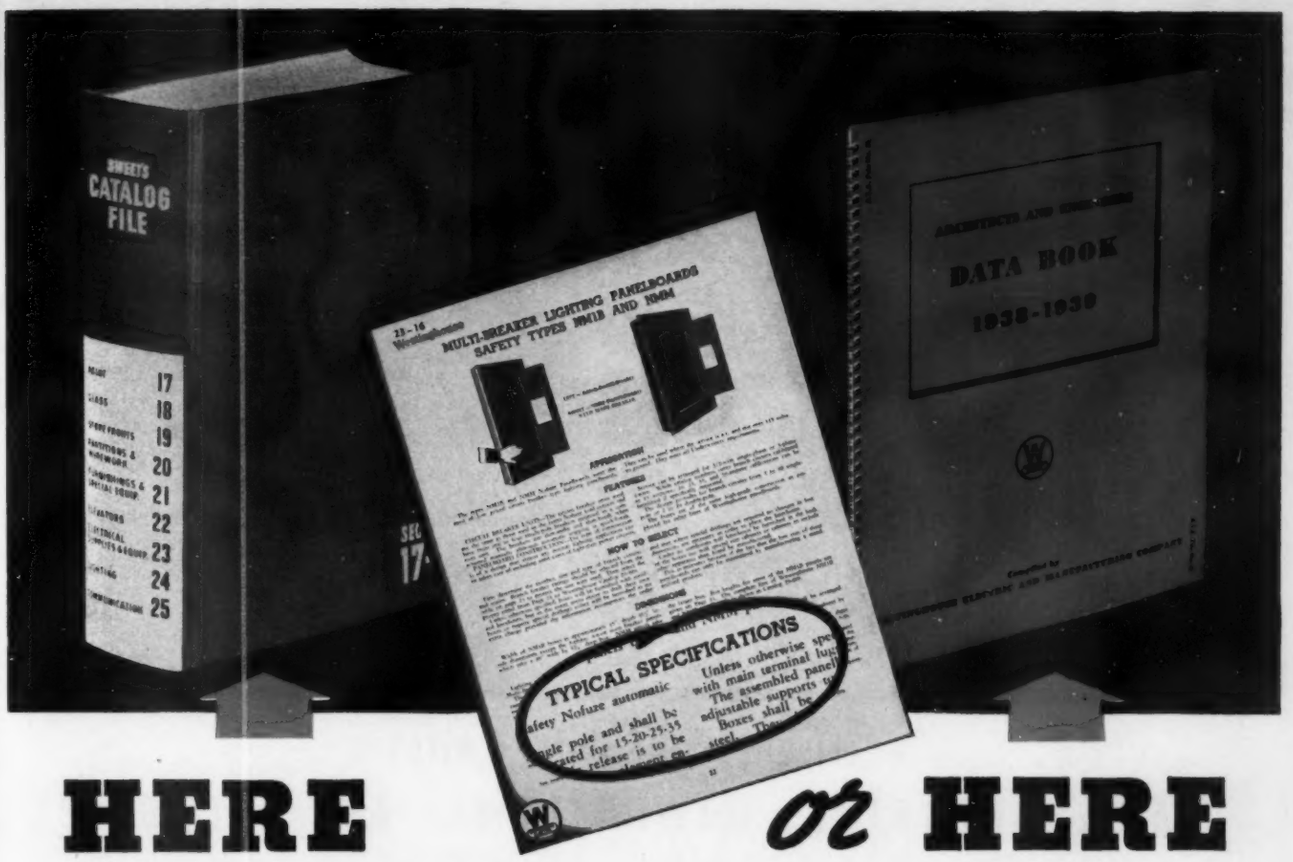
Large buildings require rectifiers and battery chargers for the operation of internal telephone, fire alarm, clock, signal systems, etc. General Electric Tungar Battery Chargers and Copper-oxide Rectifiers provide efficient and economical service of this type in thousands of apartments, hotels, office buildings and factories. Illustrated above are only two of the many available types. For additional information write to the address below.

CAT. NO. 204170 AND 199717 TUNGAR—FOR CHARGING CLOCK, SIGNAL BATTERIES, ETC.

This Tungar charges the batteries of clock, signal, control systems, etc. It is a simple, compact, half-wave outfit designed to charge from 9 to 12 cells at an adjustable rate 0.5 to 2.5 amperes. Supplied in a neat, rugged casing arranged for wall, panel or bench mounting.

For further information about G-E Wiring Materials, see the G-E Merchandise Distributor nearest you or write to Section K-944, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

GENERAL ELECTRIC



HERE *or* HERE

electrical specifications that eliminate guessing

In these two books — the electrical section of Sweet's Architectural Catalogs, and the Westinghouse Architects' and Engineers' Data Book, Westinghouse puts practical data on electrical equipment within easy reach. The forthcoming issue of Sweet's Engineering Catalogs will contain the same sort of specific information.

An easy-to-use arrangement permits the contractor to bid on just what the architect specifies — thus eliminating guesswork as to type of equipment and quality expected.

And—this same material gives the architect information on applications, features, ratings and dimensions, with typical specifications; and shows him how to select and where to buy electrical equipment for buildings.

Such information is proving valuable daily to electrical contractors and specification writers. Our local representatives will gladly help you use it to your advantage. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

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Switchboards
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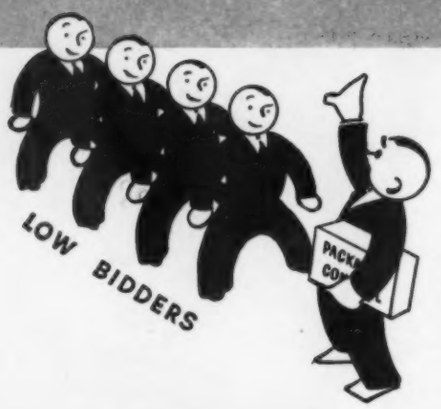
Circuit breakers
Transformers
Nofuze panelboards
Safety switches
Motors and control
Linestarters
Elevators
Lighting
Air conditioning
Home appliances
Water coolers
Convenience outlets

J-94045

Westinghouse

ELECTRICAL PARTNER OF THE BUILDING INDUSTRY

PROTECT YOUR PROFIT FROM SQUEEZED BIDS!



There is always somebody who will underbid you when you have nothing but price to offer.

The prosperous contractor knows that the way to lift himself out of price competition is to talk maintenance saving and money saving features. Note how these features pop out in the items of Westinghouse Packaged Control illustrated here.

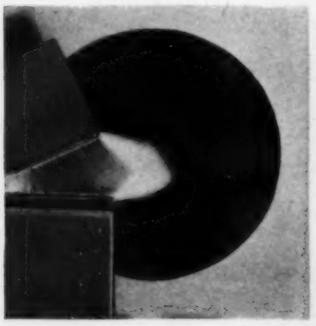
Westinghouse Safety Switches

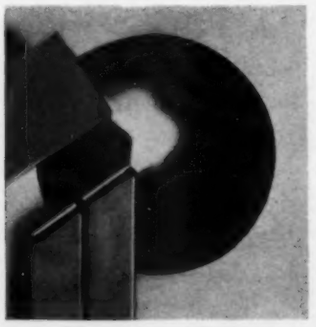
SAVE DRESSING DOWN JAWS AND BLADES!

The diamond pointed jaw and extended blade confine the arc to non-current carrying areas, leaving contact areas clean and free from beading. (Note the difference in the photos below.)

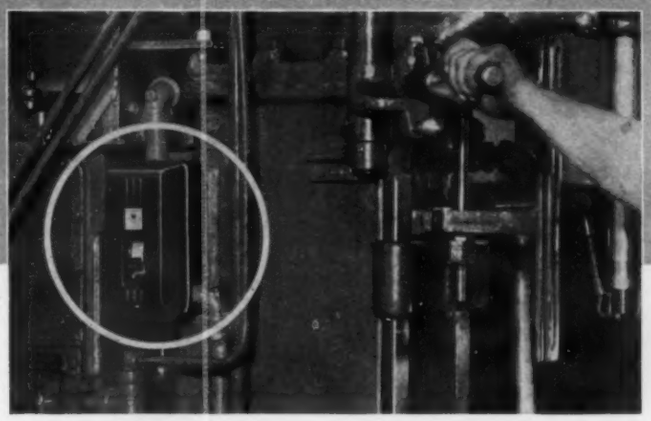
One-piece copper construction, having fewer connecting points reduces heating.

In 575 and 600 volt ratings, "De-ion" grids protect contact points — quench arcs immediately, prevent flashovers, prolong contact life.





Westinghouse



New "De-ion" Motor Watchman CAN EASILY SAVE MANY TIMES ITS COST

Here is a new manual starter for motors up to 7½ hp. It has a bi-metal disc relay that gives accurate overload protection even after repeated operation. In case of overload, it immediately cuts the motor from the line preventing damage to windings. Can easily save many times its cost in motor repair bills.

NOTE THESE FEATURES:

- **Hand operated, self indicating toggle switch.**
- **Safety interlock prevents accidental contact with live parts.**
- **"De-ion" Arc Quenchers prevent flashovers, prolong contact life.**
- **Easy to wire and mount . . . knockout space in top, sides, bottom and back of case.**

LOOK FOR THIS TRADE-MARK

See your nearest Westinghouse Distributor

Ask your nearest Westinghouse distributor for sizes, types and prices . . . push buttons, switches, control, motors and electrical apparatus.

NOFUZE CIRCUIT BREAKER saves clay plant $18.00 A DAY

The man who recommended NOFUZE Circuit Breakers to a Western clay plant saved this plant $18.00 a day in losses due to fuse outages. Naturally he made a permanent customer for himself. For your customers bothered with losses due to fuse outages, recommend the Westinghouse Nofuze Circuit Breaker.

Westinghouse Combination Linestarter

This combination builds you up with your customers. Shows them how to get all necessary devices in the motor circuit in one compact and money saving installation. It provides:

- magnetic motor starter (push button operated).
- manual disconnect switch.
- motor overload protection.
- Nofuze circuit protection.

It is all available for the cost of ONE installation.

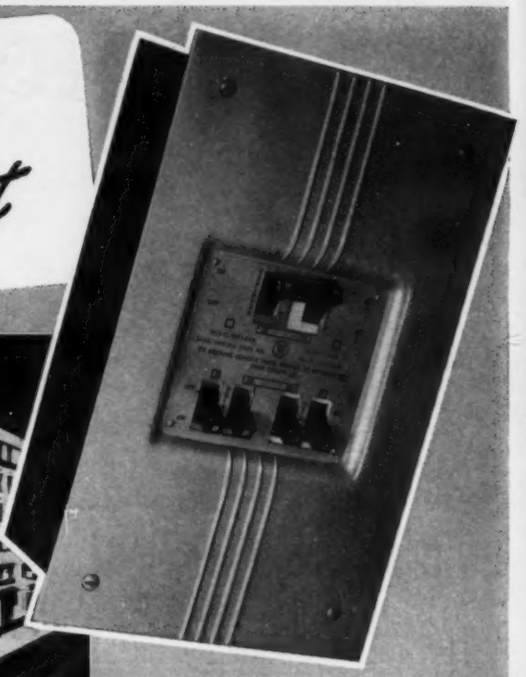
J-20837

Packaged Control

YOU CAN'T BE THE *First*
YOU DON'T WANT TO BE THE *Last*

One of Niagara Hudson's Five Star Model Homes

The Wright Building, Toronto is Nofuze protected



to get these profitable Nofuze contracts

There is money to be made . . . and this time the opportunity is knocking at the electrical contractor's door. You have seen how the builder increased his profits by recommending modern improvements . . . insulation, colorful interiors, modern convenience. You have seen the plumber cash in on modern bathroom fixtures . . . copper piping.

Now it is your turn . . . selling fuseless circuit protection and adequate wiring. Westinghouse Nofuze protection is available for every electrical circuit — for old and new homes, for office buildings, stores, commercial buildings, factories. Over 3,000,000 electrical circuits are now Nofuze protected.

Get on the band wagon . . . let the idea of safe, convenient circuit protection open the door to new profits, in *your* business. Ask your nearest Westinghouse wholesaler to demonstrate Nofuze equipment and to tell you how Nofuze protection helps the electrical contractor make money.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

J-60297-A

Nofuze Multi-Breakers for homes

Nofuze power panelboards for industrial plants

Nofuze lighting panelboards for commercial buildings

Westinghouse Nofuze Protection

EXPERTS KNOW GOOD EGGS

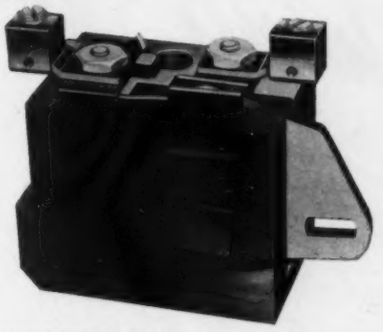
Do YOU know Good *Switches?*

Experts tell good eggs from bad by knowing the inside . . . Electrical Contractors tell good switches the same way . . . it's what is inside that counts.

Take a WADSWORTH Switch apart . . . examine carefully . . . piece by piece . . . and you will realize at once they are made of high-grade materials. You will see, too, that every part is carefully made and fitted together to work smoothly and to stand up under hard use.

In WADSWORTH Switches all current carrying parts are of ample capacity. The terminals are in plain sight and connections are easily made. There is adequate wiring space . . . and . . . with plenty of well placed — well cut knockouts they are a pleasure to work with.

WADSWORTH Switches are built to meet the Contractors problems.



Here you see WADSWORTH'S Switching Mechanism in "Off" Position. No other part of a switch is as important for satisfactory operation as it's Switching Mechanism. It is the very "heart" of any switch and must function.

WADSWORTH has one of the "finest" Switching Mechanisms and the construction is unique. The action of the cam when opening switch draws the "arc" down into the narrow non-ventilated slot where it is simultaneously quenched.

TYPE "A"
Cat. No. 8763A

TYPE "C"
Cat. No. 8563X

GENERAL DUTY
Cat. No. 8733

Three types of Wadsworth Industrial Switches are shown above. There are many other styles available.

BUY WISELY . . . . . BUY WADSWORTH

"The Profit Line for 39"

See Your Electrical Wholesaler

The WADSWORTH ELECTRIC MFG CO. INC.

Covington, Kentucky.

Comfort Cooling

American Blower starts greatest sale and ad drive in history of industry! . .

Reaching over 10,000,000 readers

A ROUND OF PARTIES LEAVES YOU FAGGED
Comfort Cooling BUILDS YOU UP
AMERICAN BLOWER
You'll find you reduce the air is FRESH
Managing a family SAPS STRENGTH

AMERICAN BLOWER COMFORT COOLING Authorized Dealer

Featuring COMFORT COOLING

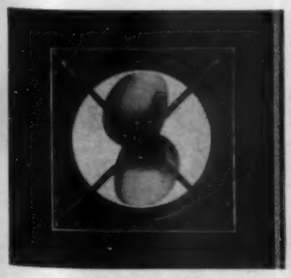
Dealers' names shown *free* in this smashing national newspaper campaign. Buyers are directed to dealers displaying this sign (furnished free to you as shown at left). Sign up now as an Authorized Dealer and reap the profits!

GOES BIG

FOR DEALERS—Free Direct Mail Helps, Widespread Publicity, Free Catalogs and Window Signs all backed by a gigantic factory-sponsored National Newspaper Program! American Blower Comfort Cooling can now be sold by dealers on long, easy terms (financed through our affiliate, the Heating and Plumbing Finance Corp.). Many of the nation's largest and best known Utilities will lend their prestige and efforts to back this gigantic campaign and help you sell.

Phone nearest American Blower Branch office or write for folder describing plan in detail.

The world's finest and most complete line of COMFORT COOLING PRODUCTS



Ventura Fan (above)

Sirocco Utility Blower

Aeropel Window Ventilator

Portable Apartment Conditioner

Home Conditioner (Attic Fan)

AMERICAN BLOWER

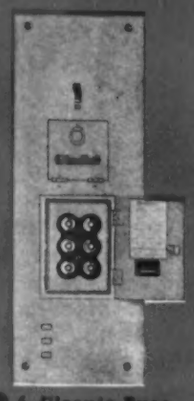
AMERICAN BLOWER CORPORATION—6000 RUSSELL ST., DETROIT, MICH. • DIVISION OF AMERICAN RADIATOR AND STANDARD SANITARY CORPORATION

EST. 1891
THE SIGN OF A FA BETTER JOB

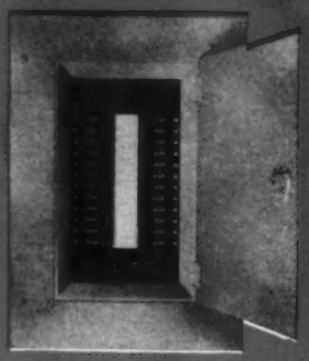
Frank Adam

PRODUCTS PARADE

FRANK ADAM ELECTRIC CO.
ST. LOUIS, MO. U.S.A.



6-Circuit Fuse Type Service Equipment.



Dublbrak Circuit Breaker Type Light and Appliance Branch Circuit Panelboard—Double Row Construction.

AC Circuit Breaker Type Light and Appliance Branch Circuit Feeder — Single Row Construction.

AC Circuit Breaker Type Service Equipment.

Security Type Fan Hanger Outlet

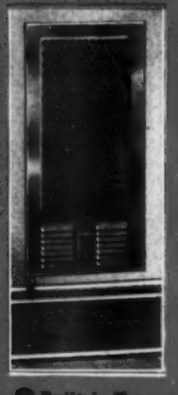
Standardized Pull Fuse Switch Distribution Panelboard.

Autrastat Dimmer Switchboard for Stage and Auditorium Lighting Control.

Dead Front Power Distribution Switchfuz and Pull Switch Fuse Switchboard.

Adjustable Floor Box

Type A Shutlbrak Safety Type Enclosed Switch.

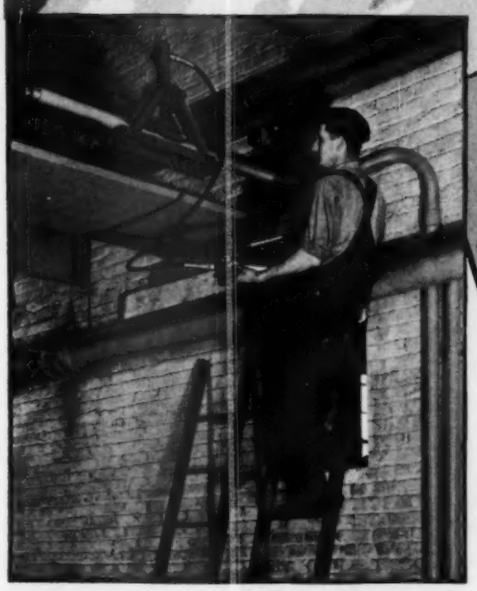


Built-in Type Electric Quikheter

Frank Adam
ELECTRIC COMPANY
ST. LOUIS

FA PRODUCTS .. "The Sign of a Better Job"

"THE MOUNTAIN COMES TO MOHAMET"



Porto-Power

Pipe and Conduit Bender Comes to the Job

THE LOW-PRICED S-30 Handles Popular Range of Work

YOU need this new S-30 Kit—with its famous 10-ton Porto-Power *Hydraulic* Unit! Light in weight and compact — easily carried to any job. Low in cost — enables you to have several kits doing bending jobs simultaneously — in one building, or at different locations. Bends or straightens 1", 1¼", 1½", and 2" rigid conduit and all standard and heavy pipe. Far ahead because it operates in any vertical, horizontal, or angular position — and its exclusive self-retracting and remotely controlled ram operates with unmatched speed, ease, and economy. Angles, bends, and offsets quickly formed without kinks. Porto-Power-formed bends are smooth — wire and cable slip through quickly and easily. What's more, with the S-30 Kit on the job — you save on the expense of elbows, couplings, and otherwise necessary cutting and threading.

Get the amazing profit-making story of this sensational Porto-Power S-30 Kit — made by Blackhawk, world's largest manufacturer of hydraulic jacks. Send the coupon AT ONCE for the 6-page illustrated folder.

BLACKHAWK MFG. COMPANY, *Milwaukee, Wisconsin*

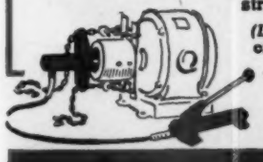
Truly portable — easy to place. Ram works in any position — remote control permits operator to use Porto-Power Kit on ladders, scaffolds, and in cramped quarters.

COMPACT — LIGHTWEIGHT

Complete kit weighs only 101 lbs. Assembly for bending 2" pipe — pump, ram, hose, and attachments — totals only 66 lbs.

DUAL-DUTY FOR PLANT ELECTRICIANS

Blackhawk also introduces the S-31 Porto-Power Maintenance Assortment. Powered with the same 10-ton Hydraulic Unit used in the Porto-Power Pipe Bender—but equipped with selected attachments for wide range of general maintenance work including: pulling and pushing gears, pulleys, wheels — lifting machinery — inserting and removing bushings, pins, bolts, and shafts — clamping parts for drilling, welding, riveting, assembling — separating dies — straightening line shafts.



(Left) Pulling drive pulley off electric motor shaft.

BLACKHAWK MFG. COMPANY
Dept. J2049, Milwaukee, Wis.
Please rush free illustrated folder "Profits with Porto-Power Industrial Assortments."

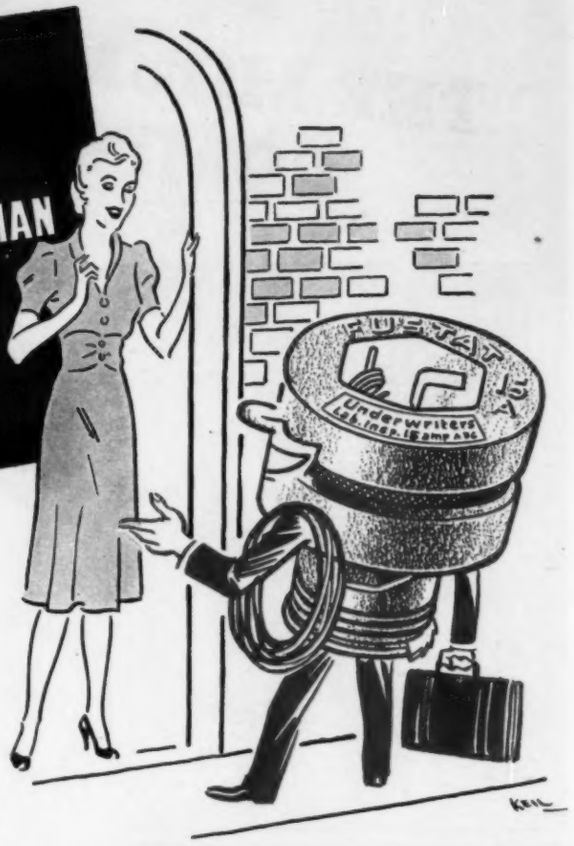
Name.....

Address.....

City..... State.....

Product of BLACKHAWK

The FUSTAT is an ADEQUATE WIRING SALESMAN that works for you 24 hours a day



It shows user need for new circuits

Permanent overloading is positively prevented. Once the correct size Fustat has been installed it cannot be replaced with a larger size and bridging it in any way is virtually impossible. If additional circuits are needed the user cannot side-step the issue at the sacrifice of safety.

It reduces low voltage complaints

The user cannot load the circuit beyond the proper capacity of the copper. This prevents a voltage drop that is so frequently the cause of complaints about toasters, percolators and other appliances not operating efficiently.

It permits more outlets per circuit

Adding a maximum number of outlets is a perfectly safe practice because the Fustat guards the circuit against overloading.

It guards against blowing of main fuses

The branch circuit Fustat will almost invariably open on a short-circuit or overload, AHEAD of the main fuse or Fustat — because it cannot be replaced by an oversize fuse or readily tampered. When it does open to protect, only the *normal load* of one circuit is off the line instead of a user possibly having all of his lights and appliances out of service because the main fuse blew.

It permits adding more appliances to present circuits

A circuit can be loaded to approved capacity without needless blows and without sacrifice of safety. The long time-lag of the Fustat keeps it from blowing on motor starting currents or other harmless overloads.

It builds user confidence in doing things electrically

The Fustat helps sell the electrical way of doing things — for it generally permits users to add new appliances without being annoyed by needless blows . . . it assures proper operation of appliances because low-voltage cannot be caused by overloading . . . it reduces chances of users being frightened by shorted cords burning up, for the quick action of the Fustat on dangerous cord shorts—prevents spraying of metal, starting of fires, burning of users . . . it helps teach user that the protective device is a desirable safeguard instead of a nuisance . . . **thus it assists the whole industry to build towards bigger business and better times.**

WHAT IS THE FUSTAT?

It is a fuse to which a thermal cutout is added.

It protects like a fuse against short-circuits — even high resistance shorts such as occur in flexible cords.

It protects against permanent overloads, even when as light as 25%.

Retails at 7½c

Yet it will not blow on motor starting currents of washing machines or other appliances.

It has a base that guards against anyone robbing the circuit of protection.

It fits Edison base fuseholders through the use of an inexpensive adapter.

It's just good business to sell, install and use Fustats

The FUSTAT

For full information write to any of these firms

BUSSMANN MFG. CO., University at Jefferson, St. Louis, Mo.
JEFFERSON ELECTRIC COMPANY, Bellwood, Ill.
KIRKMAN ENGINEERING CORP., 121 Sixth Ave., New York City
NATIONAL ELECTRIC PRODUCTS CORP., Fulton Bldg., Pittsburgh, Pa.
UNION INSULATING CO., 27 Park Place, New York City

Retails at 7½c
in 15 to 30 amp. sizes

HAZARD

OFFERS COMPLETE LINE for ADEQUATE WIRING

ADEQUATE WIRING SERVES AND SAVES

HAZARD ABN and UBN SERVICE ENTRANCE CABLE — Adequate wiring must begin with an adequate service entrance cable.

HAZARD PERFORMITE WIRE — A super-adequate wire for all important jobs. Super-aging and heat-resisting. Smaller sized copper safely carries your load.

HAZACODE FIREKROME BUILDING WIRE — An adequate wire for all ordinary service jobs. Imprinted every 2 feet. Six standard colors. National Electric Code Standard.

HAZARD WATERTITE WIRE — For adequate wiring in moist places. Replaces lead encased cable. Approved by Underwriters Laboratory Section 3035 National Electric Code.

HAZARD ARMORED CABLE — For adequate wiring on remodeling jobs use the cable with rip-cord for easy working and with flame-resisting, moisture-proof paper sheath between conductor and armor.

HAZARDEX NON-METALLIC SHEATHED CABLE — An adequate cable for interior wiring jobs. A new Hazard product, standard in construction and fully approved.

PERMEX LAMP CORD — An adequate cord for floor lamps, table lamps, radios, electric clocks, etc. A rubber sheathed, parallel lamp cord that is safe.

HAZACORD PORTABLE CORDS — 60% Mold-cured tough rubber jacket. Stands rough work on portable tools, appliances, etc.

HAZARD INSULATED WIRE WORKS

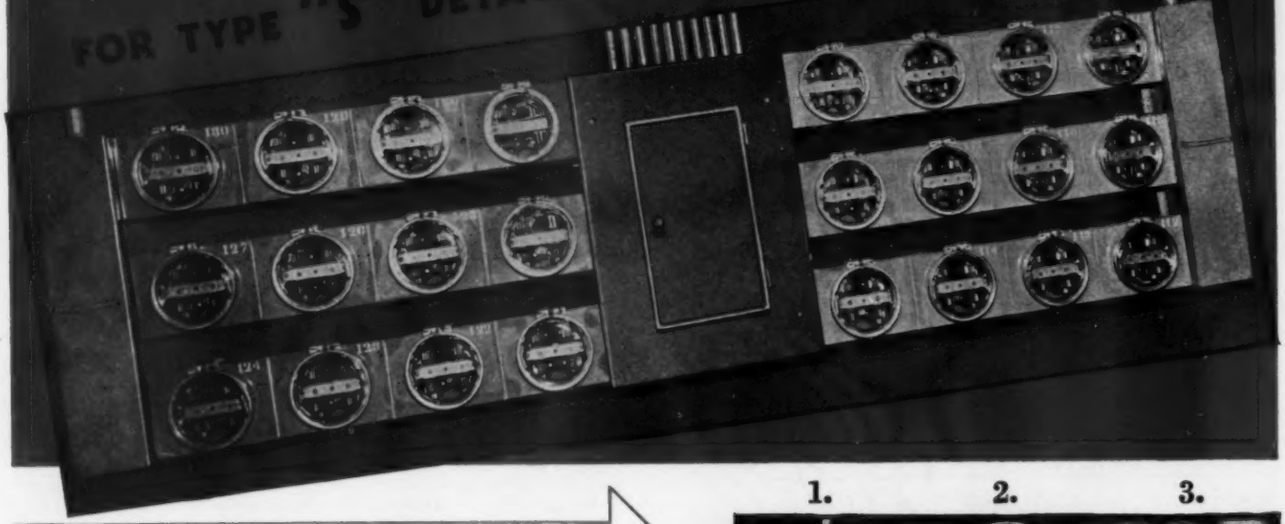
DIVISION OF THE OKONITE CO.

WORKS: WILKES-BARRE, PENNSYLVANIA

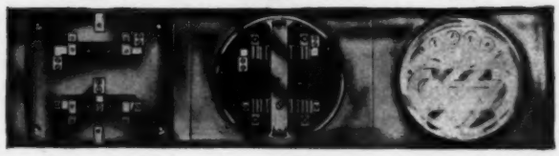
New York Chicago Philadelphia Atlanta Pittsburgh Buffalo Boston Detroit
Seattle Dallas Washington San Francisco St. Louis Los Angeles

THE *Right* METER TROUGH

FOR TYPE "S" DETACHABLE METER INSTALLATIONS



1. With cover removed.
2. With cover and socket.
3. Showing meter in place.

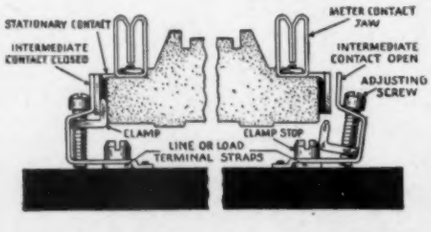


Right . . . for These Reasons

No. 2 Standard Troughs with INTERMEDIATE DISCONNECT CONTACTS (see below) permit quick, positive disconnection or restoration of service without permanently removing meter . . . a great convenience in apartment houses and other places where service is frequently discontinued for short periods.

COMPLETE UNITS, for 1, 2, 3 or 4 meters, including cover (with socket) and trough can be assembled and GANGED in any desired number to meet service requirements.

Troughs can be furnished for indoor or outdoor service. Also for polyphase meters (No. 1 Standard Troughs). Troughs have ample wiring room and are equipped with thru-type solderless connectors and solderless lugs. Finish is baked aluminum on galvanealed steel.



Right . . . for These Applications

Photograph shows typical modern Type "S" meter trough installation . . . one of 34 similar panels in a group of apartment buildings.

These meter troughs — including cover, trough only and accessories are interchangeable with those of other manufacturers of similar standardized units. Such interchangeability of parts greatly adds to economies in installation and in service maintenance for residences, garages, farm buildings, hospitals, apartments, schools, stores, theatres, etc.

Use Trumbull Meter Troughs to open up new business opportunities wherever detachable meters can be used. Sell them as a modern electrical specification both in new construction and wiring modernization. Bulletin 313 is now ready. Send for it today.

THE
TRUMBULL
ELECTRIC MANUFACTURING COMPANY
PLAINVILLE — A GENERAL ELECTRIC ORGANIZATION — CONNECTICUT

PRODUCTS THAT ARE RIGHT FOR THE JOB . . . SERVICE THROUGH WHOLESALERS AND CONTRACTORS WHO ARE RIGHT ON THE JOB

Curtis LIGHTING

"CASE STRIP"

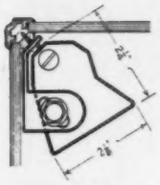
fluorescent lighting

FOR SHOWCASES

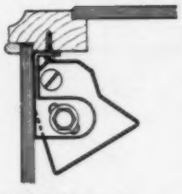
BRINGS DAYLIGHT

INTO THE SHOWCASE

AVAILABLE FROM ELECTRICAL WHOLESALERS IN STOCK SIZES TO ACCOMMODATE ONE TO FOUR FLUORESCENT LAMPS



Diagonal Mounting
Wood Frame Case



Vertical Mounting
Wood Frame Case

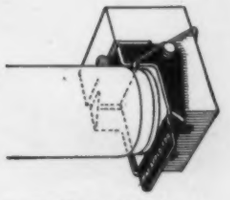
Mounting in All-Glass Case
Standard Brackets Enable Mounting in All Type Cases—No Extra Parts

ABSOLUTELY NEW and THOROUGHLY PRACTICAL

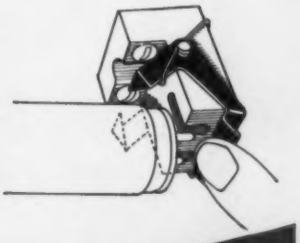
Merchants are already interested in the advantages of the Fluorescent lamp for showcases . . . in its daylight qualities . . . in its economy of operation . . . in its attention value.

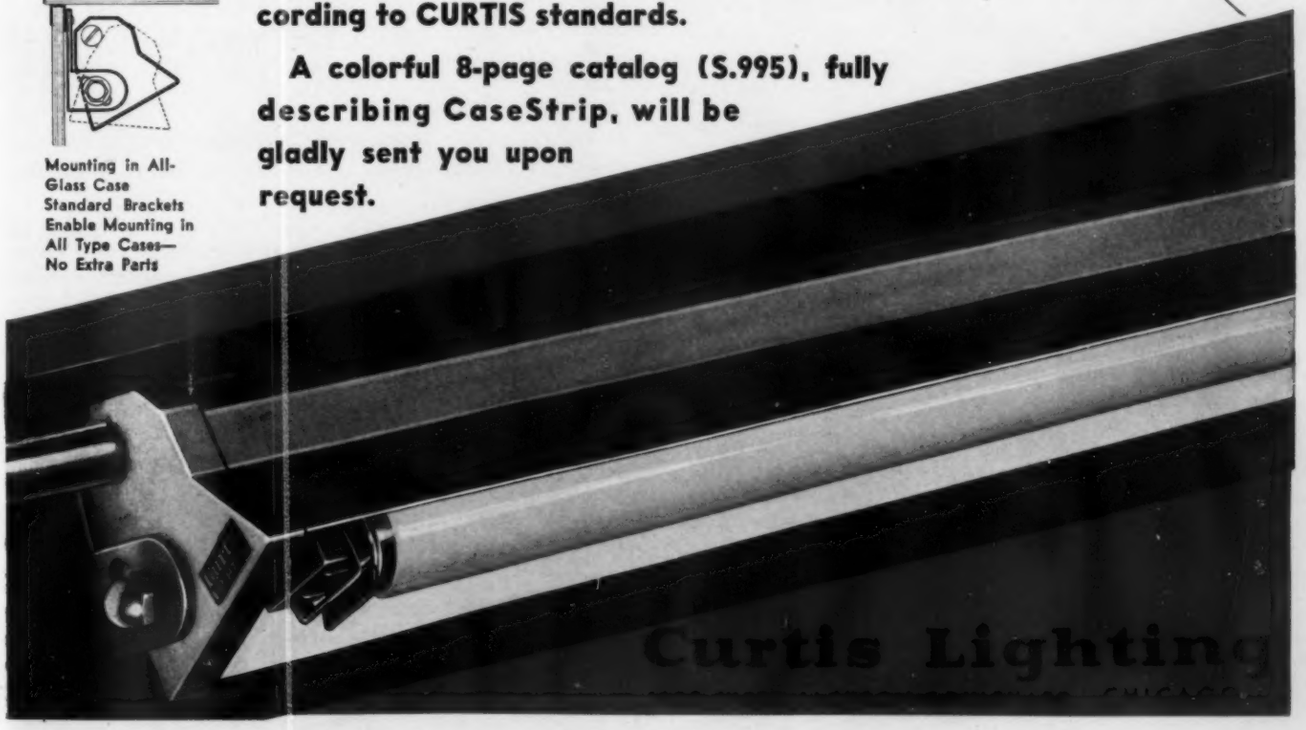
CURTIS has made Fluorescent showcase lighting practical. CaseStrip has all the practical features a contractor would design into the equipment himself. Small . . . distinctive . . . economical . . . easy to wire and install—no threading or splicing. CaseStrip has been engineered and manufactured according to CURTIS standards.

A colorful 8-page catalog (S.995), fully describing CaseStrip, will be gladly sent you upon request.



Curtis Ejector-Guards Facilitate Relamping and Secure Lamps





A NEW BOOK!

"The Meaning of the RLM *Label"*

Today more than ever before, those who purchase and specify products for use in industry are insisting upon basic standards by which they may judge accurately the value of the product from quality and performance standpoints.

In the field of Industrial Light Conditioning, the RLM STANDARDS INSTITUTE is meeting this demand by establishing standards of efficiency, design and quality for Industrial Lighting Reflectors.

The necessity for these standards, what they are and how they may be used to insure proper specification of lighting equipment from both the viewpoint of cost and performance is the subject of the booklet—"The Meaning of the RLM Label."

Into the book has gone the composite experience and knowledge of the engineering departments of the leading manufacturers of lighting reflectors associated in the RLM STANDARDS INSTITUTE.

This book is available without cost to industrial executives, consulting engineers, illuminating engineers, plant engineers, purchasing agents and all others interested in the proper specification and installation of industrial lighting equipment. Your request for a copy is most cordially invited.

The letters RLM stand for Reflector and Lighting equipment Manufacturers

RLM STANDARDS INSTITUTE
INCORPORATED

20 N. WACKER DRIVE · SUITE 1130 · CHICAGO, ILL.

THE CERTIFICATE OF RLM UNIFORM QUALITY

Specify- FARADAY

DEVEAU

PR ECLIPSE

SCHWARZE

. . . AND GET THE BENEFIT OF THIS COMBINED LINE OF SIGNALING DEVICES and SYSTEMS

● The name "FARADAY" long ago established a reputation for quality and dependability that is recognized everywhere . . . . so, when "FARADAY" appears on a specification, you can be sure the resulting installation will reflect the fullest possible measure of efficiency and economy. Now, joined with three other famous names in signaling devices and systems, "FARADAY" offers you the most complete line of equipment available from one source of supply. Let us send you our catalog and see for yourself how it fills every conceivable signaling requirement.

STANLEY & PATTERSON
Division of
SCHWARZE ELECTRIC COMPANY
Adrian, Michigan

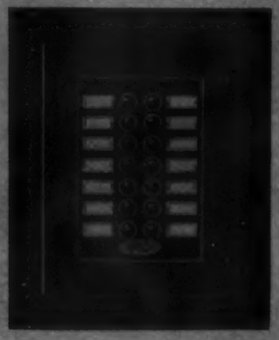
SCHOOLS...

CAT. NO. 5024-M

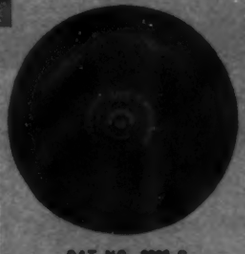
CAT. NOS. 1686 & 1687

HOSPITALS...

CAT. NO. 5189



CAT. NO. 110



CAT NO. 6006-G

INDUSTRIALS...

CAT. NO. 2041

THE SCHWARZE KODAIRE

CAT. NO. 2022

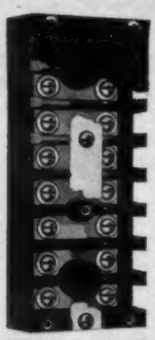
CAT. NO. 1909

Get PRE-PROVEN DEPENDABILITY . . .
Get MORE MODERN DESIGNING . . .
Get UNIFORM HIGH QUALITY . . .
All in the One Line... "PENN UNION"!

JUST A FEW of the THOUSANDS of items in the PENN-UNION line:

SERVICE CONNECTORS

DIE CAST ALUMINUM METER ENCLOSURE CABINETS


TERMINAL BLOCKS

TEE CONNECTORS

TEE CONNECTORS

EZ TERMINALS

SOLDERLESS LUGS

CABLE CLIPS

UNIVERSAL CLAMP

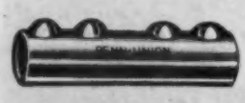
SERVICE ENTRANCE CONNECTORS

SOLDERING LUGS

TERMINAL LUGS

SPLIT TINNED SLEEVES

TEE CONNECTORS


SET SCREW CONNECTORS

BATTERY CLIPS

FUSE CLIPS

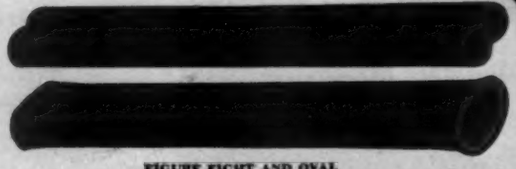


FIGURE EIGHT AND OVAL TUBE SLEEVES

You're sure it's Dependable when it's a Penn-Union fitting. Every item carefully designed, thoroughly tested. Preferred by leading utilities and "industrials" for their Modernness . . . Time-Saving features . . . Uniform High Quality.

For all combinations of tube, bar, cable and wire — all sizes.

PENN-UNION ELECTRIC CORPORATION, Erie, Pa.

PENN-UNION

SOLD BY LEADING JOBBERS

. . . and how about some PRIVATE INTERIOR TELEPHONES ?

INTERCOMS

Common-talking, selective-ringing systems in capacities of two to eleven stations. Beautifully designed, and durably constructed for long, faithful service. Operate from dry cells or battery eliminators.

AUTO-COMS

Deluxe intercom. systems, providing selective talking and selective signaling service for a maximum of ten stations, and up to five connections at one time. No automatic switchboard needed.

SERV-U-FONES

Attractively priced common-talking systems in capacities of two to ten stations. Conveniently packaged, simple to install. Operate from dry cell batteries.

P-A-X'S

Private Automatic Exchange systems, available in all capacities. Use standard automatic telephones and provide for a variety of special communication services.

You have many opportunities to "plug" Automatic Electric private interior telephone systems and thereby cut yourself in on some extra profits.

And now is the time to push interior telephones as business has really become communication conscious, genuinely appreciates the value of fast intercommunication facilities and—most important—is ready to buy.

As the nature of this equipment places it in your field, you are the logical supplier. Go after this business—we'll help you!

Automatic Electric, for over 40 years manufacturers of both public and private telephone equipment, offers private interior systems to fit any office, shop, factory or home. Shown on this page are four of the many types of systems available.

Our field representative will be pleased to supply you with literature, prices and discounts as well as to work with you on particular jobs. Talk to him.

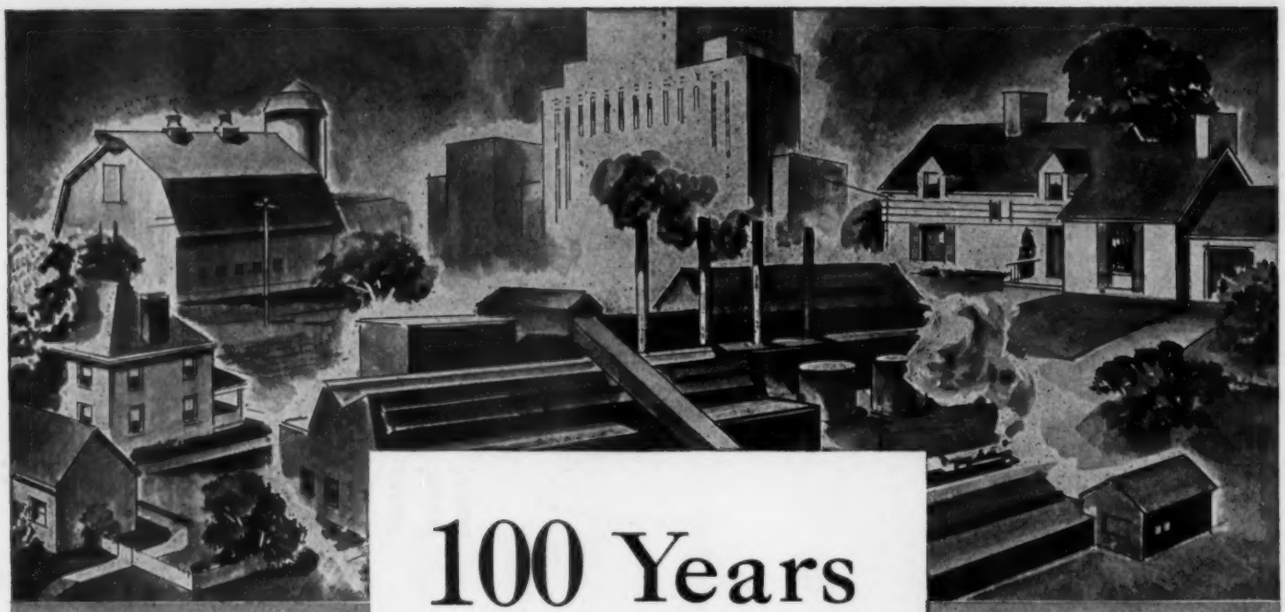
Automatic Electric Intercommunicating Systems are designed for private service. They cannot be connected with the public telephone system.

AUTOMATIC ELECTRIC

PRIVATE INTERIOR TELEPHONE SYSTEMS

Distributed by: AMERICAN AUTOMATIC ELECTRIC SALES COMPANY, 1033 West Van Buren Street, Chicago, Illinois

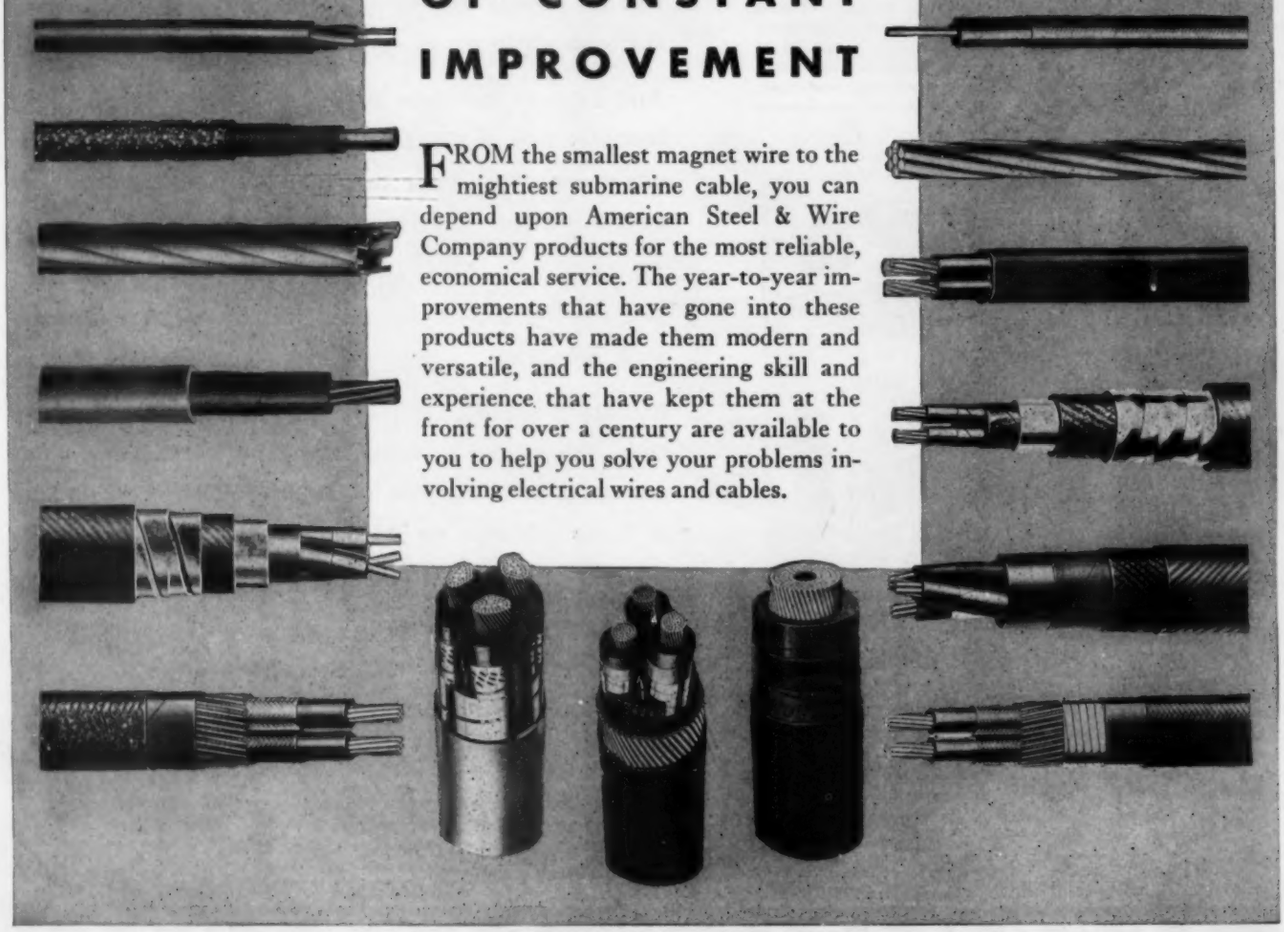
Sales and Service Offices in Principal Cities • In Canada: Canadian Telephones & Supplies, Limited, Toronto



100 Years

OF CONSTANT IMPROVEMENT

FROM the smallest magnet wire to the mightiest submarine cable, you can depend upon American Steel & Wire Company products for the most reliable, economical service. The year-to-year improvements that have gone into these products have made them modern and versatile, and the engineering skill and experience that have kept them at the front for over a century are available to you to help you solve your problems involving electrical wires and cables.



AMERICAN STEEL & WIRE COMPANY

Cleveland, Chicago and New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* • United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

ARROW Interchangeable Line

From an assortment of INTERCHANGEABLE Wiring Units, you can make up any desired arrangement of Switches, Receptacles, Radio Outlets, Pilot Light or Night Light Combinations, and others. Here are the makings of *any* single or multiple-gang devices the job requires.

The Units are quickly assembled by attaching to metal yoke supplied with each plate. They are fastened — rigidly and permanently — by the mere twist of a screwdriver.

Interchangeable Units make your *stock* more flexible: — cover your needs with a smaller inventory.

Send for catalog supplement listing *all* the Interchangeable Units from which to make up your assortment.

ADEQUATE WIRING SERVES AND SAVES

ARROW ELECTRIC DIVISION
THE ARROW-HART & HEGEMAN ELECTRIC CO. HARTFORD, CONN.

ARCHITECTS — CONTRACTORS
ELECTRICIANS — BUILDERS
Approve Specifications for
RACO·ALL-STEEL·PRODUCTS

SWITCH BOXES — OUTLET BOXES
CUTOUT BOXES — CABINETS
FUSE CABS — CONDUIT FITTINGS

RACO • ALL-STEEL Galvanized Box Material complies with Federal Specification W.O. 821-A.

Designed to meet present day wiring requirements economically and effectively. RACO • ALL-STEEL • PRODUCTS have won nationwide acceptance. They provide many advantages for *new* jobs as well as rural and urban modernization jobs.

Developed by competent engineers who keep pace with modern wiring trends, RACO • ALL-STEEL • PRODUCTS offer numerous improvements which are of importance to everyone in the building and electrical industries—for example: "Pry Outs," the modern knockout—"Extended Ears," the ideal new-work switch box—"Receptacle Boxes," properly gauged for mounting receptacles in plaster or baseboard—"Wall Bracket Boxes," to assure perfect alignment of side-wall bracket fixtures. "Twin-Bracket Boxes," oversized, positive alignment; rigid two-way support, "JAY-KAY" Clamps, external cable clamps, making full capacity of the box, available for splice—"Hi-Lo" Barriers, standard Raco • All-Steel boxes may be used with this barrier, separating high and low voltage; "Two-Way" clamps, affording entrance to switch or outlet boxes through side or bottom knockouts *or both simultaneously*—and many others.

The total of more than 40 years of experience behind the products carrying the famous RACO and ALL-STEEL trade-marks is your assurance of continued quality and dependability. Write for catalog illustrating the complete line—there is no obligation.

Distributors in all important centers.

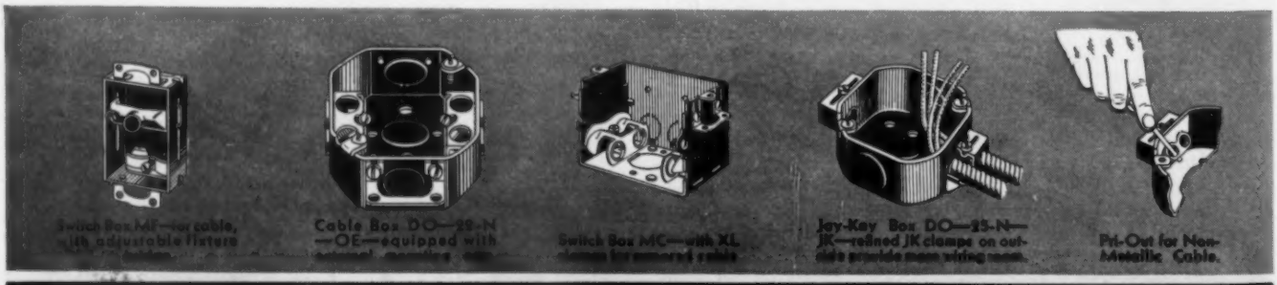
DISTRIBUTED NATIONALLY BY

ALL-STEEL-EQUIP COMPANY
INCORPORATED

104 Griffith Ave. **Aurora, Illinois**

Factories: South Bend, Indiana—Aurora, Illinois

A few of the products in the complete Raco • All-Steel • Products line:


Switch Box MF—for cable, with adjustable fixture
Cable Box DO—29-N —OE—equipped with
Switch Box MC—with XL
Jay-Kay Box DO—25-N— JK—refined JK clamps on out-
Pri-Out for Non-Metallic Cable.

RACO • ALL-STEEL • PRODUCTS
SWITCH BOXES • OUTLET BOXES • CUTOUT BOXES
CABINETS • FUSE CABS • CONDUIT FITTINGS

Building Better Safety Switches

. . . is just an old Custom at Colt's

and the better we build 'em . . . the easier you sell 'em!

No. 75937
A big, husky 600 ampere Colt Quadbreak Safety Switch.

Quadbreak

No. 75931
QUADBREAK SAFETY SWITCH
FOR 575 VOLT CIRCUITS
These switches utilize the famous Quadbreak mechanism . . . outstanding because of its efficiency, safety and long life. Available in sizes from 30 Amperes to 1200 Amperes.

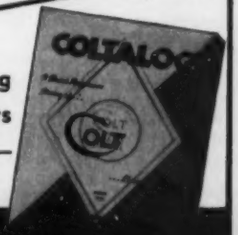
Dualbreak

No. 27231
DUALBREAK SAFETY SWITCH
FOR 230 VOLT CIRCUITS
Colt Dualbreak Switches are similar in design to the Quadbreak units . . are equally rugged and dependable. 30 to 1200 Ampere sizes.

Weatherproof

No. 99633
WITH WEATHERPROOF CABINET
These devices are enclosed in Heavy Cast Iron Cabinets . . resist moisture, dust and destructive fumes. Dualbreak mechanism assures long life and absolute safety.

New a complete condensed listing of all Colt Electrical Products in the new COLTALOG—
Your copy is ready — Send for it today.



COLT

ELECTRICAL PRODUCTS

MANUFACTURED BY A WORLD FAMOUS ORGANIZATION
COLT'S PATENT FIRE ARMS MFG. CO., HARTFORD, CONN.
ELECTRICAL DIVISION

CLEVELAND SWITCHBOARD PRODUCTS... Combine for Savings!

THIS NEW KIND OF CONDUIT HANGER *plus* CLEVELAND TRIPLE "S" SWITCHBOARDS

save on

- INSTALLATION COSTS
- FLOOR SPACE
- MAINTENANCE AND INSPECTION TIME
- ALTERATION EXPENSE

● Installation after installation gives added proof that the new principle of the CLEVELAND CONDUIT HANGER makes wiring easier to handle, offers extreme flexibility in use and not only, thereby, saves substantial time on the job, but improves its appearance and serviceability.

With the same idea of savings in mind, Cleveland Triple "S" Switchboards are truly designed with the problems of installation and use in mind. Partitions that only interfere with ease of installation have been completely omitted and all parts are made removable without disturbing the balance of the board. From the standpoint of the customer, this absence of partitioning guarantees freer air circulation and longer life . . . and the lack of crowding throughout allows for easier inspection and less troublesome maintenance.

Decide now to investigate this combination of "Designed for Savings" equipment and you'll readily understand why more and more architects, engineers, and contractors are turning to *Cleveland Conduit Hanger* and *Triple "S" Switchboards.* Our new specification manuals describing both are yours for the asking.

See how easily and rigidly conduit can be hung with but one screw to tighten . . . and how neatly and compactly the Switchboard has been designed. But that's only *half* the story . . . send for full details.

The CLEVELAND SWITCHBOARD CO.
2927 East 79th Street . . . . Cleveland, Ohio
Branch Offices in all Principal Cities

WIRING SPECIFICATIONS CALL FOR

More than a Name... when they say:

"Latrobe" FLOOR BOXES AND WIRING SPECIALTIES

NO. 330 "LATROBE" TOM THUMB UTILITY OUTLET

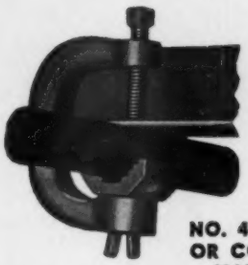
For use in wood installations, and other locations free from moisture or mechanical injury.

NO. 284 DUPLEX RECEPTACLE NOZZLE

Neatest and most compact fitting obtainable. Available with ½" or ¾" brass pipe extension. Fullman also offers Duplex Telephone Nozzles.

NO. 254-R TWO GANG BOX

Two gang Adjustable Floor Box with No. 208 Receptacle in one section. One cover plate with ½" Flush Brass Plug and the other cover plate with 2" Flush Brass Plug.

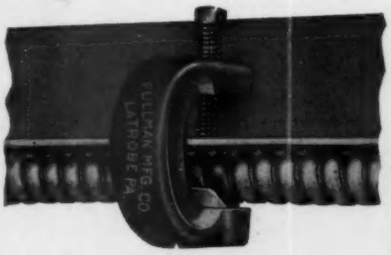


NO. 470 PIPE OR CONDUIT HANGER

Pipe support can be turned freely, permitting pipe to run parallel, or at right angles to beam. Eliminates drilling or use of straps. Will accommodate sizes of ½", ¾" and 1" pipe to steel beams ⅜" thick.

NO. 285 DOUBLE DUPLEX RECEPTACLE NOZZLE

The most attractive, compact and easy-to-install fitting on the market. Shown in illustration with No. 200 Cover Plate.



NO. 480 "BULLDOG" ARMORED CABLE SUPPORT

A new, lightweight, strong clamp for supporting or hanging cable to steel framework. Permits hanging from any angle. Best and most economical way of temporarily or permanently installing armored cable in buildings of steel construction.

INSULATOR SUPPORT

NO. 130 ADJUSTABLE WATERTIGHT FLOOR BOX

No. 130 Box with No. 207 Bell Nozzle. Cut-away view illustrates how tapered unit receptacle fits tapered opening in adjustable ring. Design eliminates many small parts. Cover plate 3½"—overall height 3½".

NO. 110 NON-ADJUSTABLE WATERTIGHT FLOOR BOX

Cut-away view showing how tapered unit receptacle fits tapered opening in top of box body. The last word in design, appearance, and simplicity of installation.

When you specify or use the Fullman Line, you not only "write" easier installation and substantial savings in time into a job, but you assure longer life and better service after it's completed.

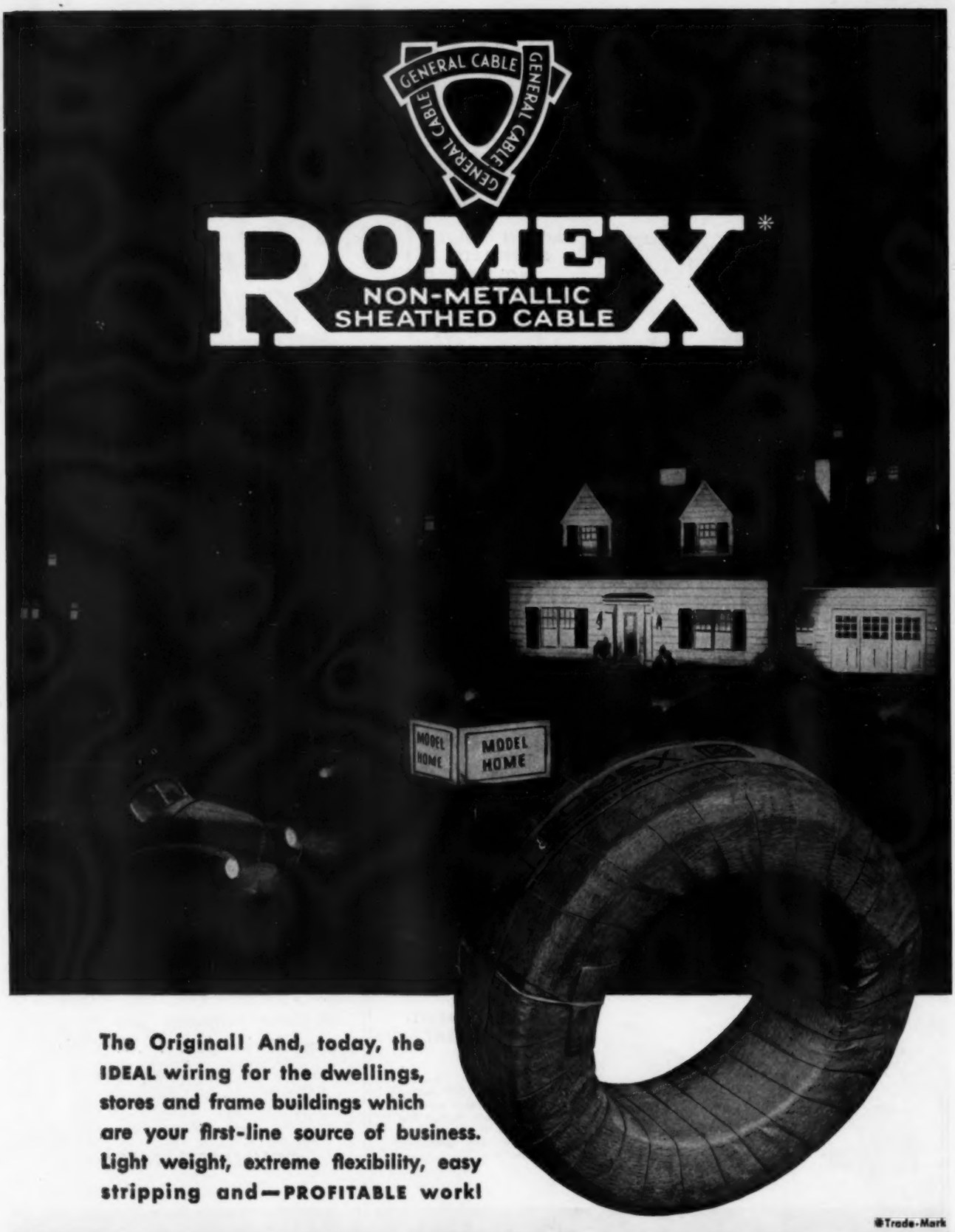
These quality products are easily and quickly installed because of their simple, practical design . . . no tiny screws or intricate parts are necessary. And, because of their sturdy construction, they *stay on the job!*

So, figure on putting Fullman to work for you on the next job! Write today for our latest catalog, showing a complete selection of floor boxes, insulator supports, fish wire, conduit benders . . . their prices are extremely reasonable.

WRITE FOR COMPLETE CATALOG

Fullman Manufacturing Co.

LATROBE, PA.



The Original! And, today, the **IDEAL** wiring for the dwellings, stores and frame buildings which are your first-line source of business. Light weight, extreme flexibility, easy stripping and—**PROFITABLE** work!

*Trade-Mark

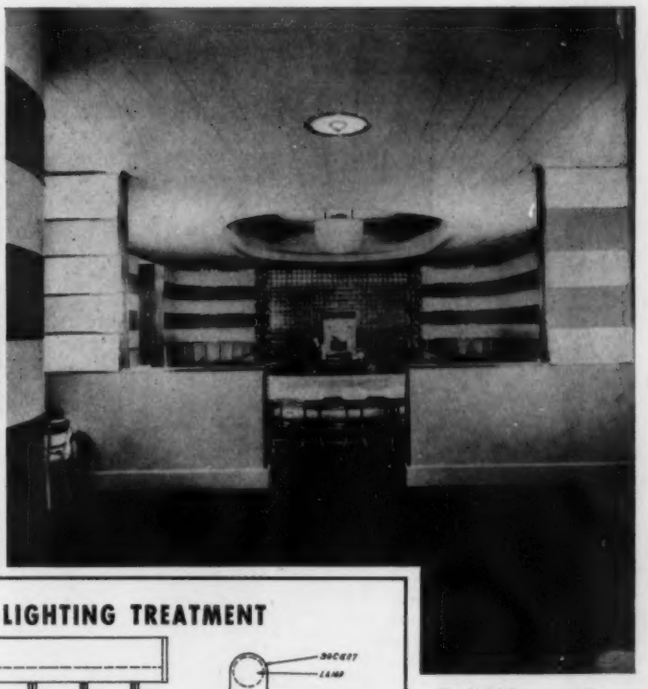
GENERAL CABLE

General Cable Corporation Sales Offices: ATLANTA • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DALLAS • DETROIT KANSAS CITY (MO.) • LOS ANGELES • NEW YORK • PHILADELPHIA • PITTSBURGH • ROME (N.Y.) • ST. LOUIS • SAN FRANCISCO • SEATTLE • WASHINGTON (D.C.)

Fluorescent Lighting turns **NIGHT** *into* **DAY**

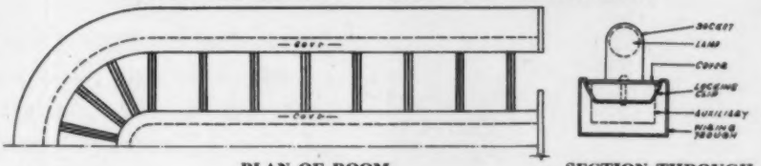
at FAN AND BILL'S STEAK HOUSE

The dining room at Fan and Bill's is lighted with pink and daylight fluorescent lamps concealed in the ceiling cove. The Acme Electric Company of Glens Falls made the electrical installation. William H. Vaughan of Saratoga was the architect.



Daylight fluorescent lamps in a special ceiling cove above the cocktail bar provide a generous amount of "indoor daylight" that lends a festive note to the decorative scheme.

DINING ROOM COVE LIGHTING TREATMENT



PLAN OF ROOM

SECTION THROUGH WIRING TROUGH

AN installation of General Electric Fluorescent MAZDA lamps turns night into day at the *Fan and Bill's* new plank steak house near Glens Falls, N. Y.

Concealed in a center ceiling cove in the dining room, 46 pink fluorescent lamps provide a roseate color of light that guests find extremely flattering. In addition, 60 daylight fluorescent lamps rim the outside perimeter of the cove. Lighting in the cocktail bar is supplemented with daylight fluorescent lamps also concealed in a ceiling cove.

G-E Fluorescent MAZDA lamps give several times more light than incandescent lamps of the same wattage and color . . . and for the same amount of light, they are 50% cooler. The daylight lamp gives the closest approach to real daylight yet produced at high efficiency. The colored lamps—pink, blue, green, red, gold, and warm white—offer electrical contractors wide opportunity for decorative effects.

Because the sale of these lamps is limited to those channels that can handle the necessary installation work, electrical contractors can make a double profit . . . from the sale of the lamps and from the installation work.

For useful information, write General Electric Co., Dept. 166-EC-D, Nela Park, Cleveland, O., or mail coupon at right.

G-E Fluorescent MAZDA lamps come in 18, 24, 36, and 48-inch lengths and in several wattages. Because they are essentially arc lamps, they require special control equipment now available.

General Electric Co., Dept. 166-EC-D,
Nela Park, Cleveland, Ohio.

Please send your new free booklet giving useful information about G-E Fluorescent MAZDA lamps.

Name .....

Company .....

Street .....

City ..... *State* .....

GENERAL ELECTRIC

FLUORESCENT MAZDA LAMPS

NOW

A G-E "Regulator" to Give You Better Lighting—Better Motor Performance

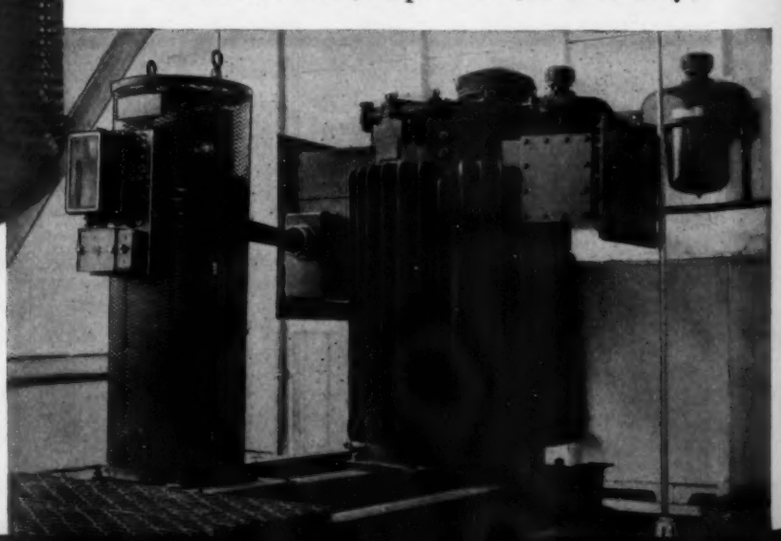
The new line of G-E air-cooled regulators includes regulators for automatic and for hand operation in single-phase ratings from 1.2 kva to 12 kva. For the regulation of lighting and power circuits, 10 per cent raise and 10 per cent lower are provided. The line also includes regulators with 100 per cent raise and 100 per cent lower—for testing purposes and for the control of voltage in industrial processes, such as those using resistance or induction furnaces

YOU know that voltage delivered at the correct level at your service entrance may fluctuate widely on your plant circuits because of varying power loads and lighting loads. You also know the advantages—in higher efficiency and increased production—of maintaining correct voltage on these circuits.

Now you can do it—economically—with the new G-E air-cooled induction regulators. They operate on the same principle as the larger units used by power companies. They give a smooth, precise voltage regulation that means better lighting, better motor performance, and better service from other electric equipment.

They are easily installed. Because they are air cooled, they require no expensive fireproof vaults. They take little space, and can be placed in out-of-the-way locations, even on beams up near the ceiling.

Find out for yourself how little these regulators cost. Ask your G-E representative for details, or write for Bulletin GEA-3057. Address General Electric, Dept. 6-201, Schenectady, N. Y.



This automatic air-cooled regulator, installed next to a Pyranol transformer on an overhead platform, regulates a lighting circuit in a modern factory

GENERAL ELECTRIC

350-144

CONTRACTORS *WHO USE* AND ARCHITECTS *WHO SPECIFY*

ILLINOIS PORCELAIN

★ ***can guarantee completely insulated wiring systems***

★ ***can establish themselves securely with their customers***

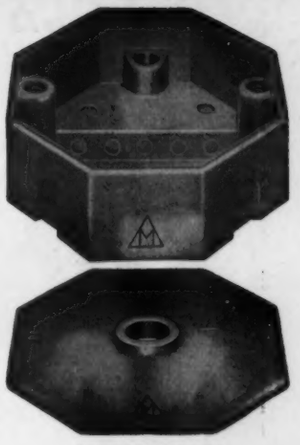
★ ***can make each job a quality one***

★ ***can build up business and increase profits***

★ ***can meet every requirement most modernly***

★ ***can guarantee every wiring device carries the Underwriters' Laboratories label***

Here is the opportunity for Architects to specify and Contractors to install completely insulated wiring systems of porcelain, which are safe, economical, efficient, and easy to install. Illinois Porcelain has made this system available for residential and farm wiring where permanency and utmost safety are of prime importance. In addition, they are especially suited for industrial installations, warehouses, cold storage and packing plants, dairies, chemical works, ice plants, breweries, or any place where dampness and fire hazards are prevalent. The use of this system renders grounding unnecessary and makes possible a safe and economical wiring system that lasts indefinitely.



OUTLET BOXES

Glazed and unglazed styles conforming to all existing standards of dimensions, spacing, position of knockout holes, and mounting screws. High mechanical and electrical efficiency.

STANDARD TUBES

In sizes ½ to 48 inches long, 5/16 to 3 inch diameter in following types: unglazed, glazed, split, floor, split floor, headless, curved end, crossover split, and crossover. Diameters all uniform both inside and outside.

SWITCH BOXES

Insure greater safety in wiring and the elimination of all grounding hazards. Made of best quality white porcelain. Metal inserts are placed in two holes of the switch boxes for receiving screws of standard switches, plug outlets, etc. Knockouts for single wires, also for cables. Specify and use them.

KNOBS

Cement coated—nail—genuine leather washer—code standard. They don't chip when driven in and they do stay in place and have a firm grip.

Profit by using

ILLINOIS AS YOUR SOURCE OF SUPPLY

ILLINOIS ELECTRIC PORCELAIN CO.
MACOMB, ILLINOIS

to Standardize on

ILLINOIS

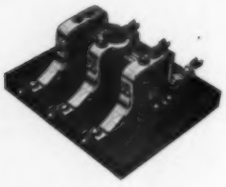
is a Progressive Step

Turn Lights "On" and "Off"

with "DIAMOND H" REMOTE CONTROL SWITCHES

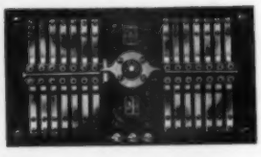
for all types of group Lighting Circuits

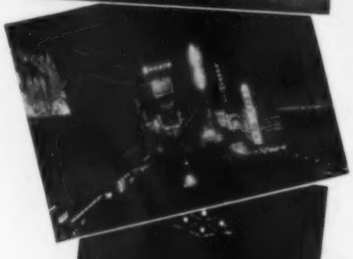
Churches



Hotels

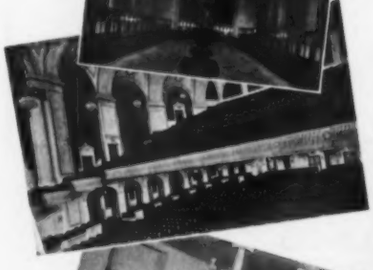
Schools





Signs

Banks



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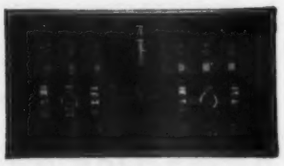
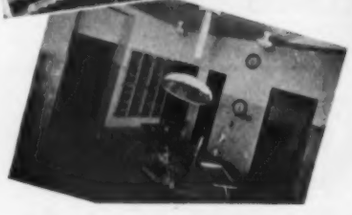




Hospitals

During the past twenty-five years many of the outstanding buildings built in this country were equipped with "Diamond H" Remote Control Switches. Architects, engineers and electrical contractors selected "Diamond H" because they are built to do the job, and they never fail to do it. They are Dependable, Save wiring costs, Serve you long and faithfully.

TYPE "F"

This switch has wide application for the control of a variety of standard circuits. For instance-Signs and flood lighting, Stairways, halls and general lighting of office buildings, general lighting of banks, libraries, stadiums, railway stations, store and window lighting. Wherever many circuits feed many lights, and convenient control from one or more distant points is desired.

TYPE "G"

To safeguard houses and grounds, docks, piers, warehouses and storage places this multi-circuit switch is a protection to foil thieves, trespassers and kidnappers. Master switches instantly flood premises with light, the thieves greatest enemy.

TYPE "H"

Some kinds of buildings where many people gather present hazards and lights must not fail. For instance in schools, churches, theatres, hospitals and now all passenger vessels, emergency lighting circuits should be used. Type "G" shifts automatically from main to emergency supply and lights do not fail.

On that next job include "Diamond H" remote control switches. Our engineering department offer their aid in correctly applying them.

Bulletin 10-C and Data sheets with wiring plans should be in your files. If you haven't a copy send for it now.

The HART MANUFACTURING CO.

HARTFORD CONN.

DIAMOND H SWITCHES

PAINE

No product may bear this name unless it incorporates features that make it outstanding among its kind

Architects Specify... and Contractors Prefer THESE SUPERIOR FEATURE HANGER and ANCHORING SPECIALTIES...

For Making Holes in

This rotary drill point is sensationally fast, quiet and long-lived. Makes holes clean, exact and free from splintered edges. A great saver of material.

Fig. 365

PAINE *Sudden Depth* Rotary Drill Point

Twenty-seven years of leadership in our field have placed Paine Products in the stocks of practically every Jobber of Electrical Merchandise in America. Consult the check list of Paine Products for the best of their kind that money can buy. They cost no more.

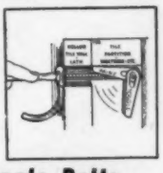
✓ ✓

- Toggle Bolts.
- Ceiling Box & Fixture Hanger.
- Lead or Steel Expansion Anchors.
- Sectional Switch Boxes.
- Cable, Conduit & Pipe Clamps.
- Hanger Ring & Bolts.
- Threaded Rod.
- BX Staples.
- Pipe Straps.
- Romex 1 or 2-Hole Straps.
- Flat End Lag Screws.
- Combination Adjustable Conduit Hangers.
- Star Drills.
- Sudden Depth Rotary Drill Points.
- Adjustable Concrete Inserts.
- Perforated Metal Extension Tape.

Secure Anchorage in Hollow Places

Fig. 123

Paine original Spring Wing Toggle WORKS INSTANTLY . . . IN ANY POSITION . . . IN ANY HOLLOW PLACE. Any size, any style Bolt Head. Now sold in the new, economical and handy package of ten . . . just ask for the PACK O' TEN.

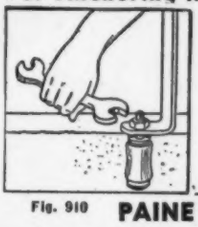


PAINE *Spring Wing* Toggle Bolts

For Anchoring in Solid Materials

Strongest on Pull Test

Here is the ideal anchorage in concrete, stone, brick, slate, marble, glass, mosaic and similar materials. PAINE NEW MIX alloy provides greater safety in use. Armour Institute figures show PAINE to be strongest of all on pull test or holding strength.

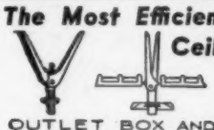


LEAD ANCHORS

Fig. 910

PAINE Lead Expansion Anchors

The Most Efficient of All Hangers for Ceiling Boxes and Fixtures



OUTLET BOX AND FIXTURE HANGER

Fig. 400

Approved by Underwriters' Lab. Eliminates extra parts. Completely rust-proofed. Rugged and strong. Merely attach ceiling box and fixture to this hanger, first—then insert hanger unit wings through as small as 1⅛" opening and tighten locknut. It saves time and overhead work.

PAINE Ceiling Box and Fixture Hanger

You Can Depend on This One

Fig. 300

The Paine Adjustable Concrete Insert design offers maximum holding power. The adjustable feature provides a wide working tolerance that means time and money saved in installation. We believe this to be the easiest-to-use and the most efficient concrete insert ever developed for Electrical Contractors, for conduit suspension.

PAINE Adjustable Concrete Insert

"Air Conditioned" Clamps

Fig. 445

←Air Space

This air space next to the anchoring surface retards rust and rot in wet places of your conduit line.

←Patented Slot

This patented bolt slot permits insertion of the bolt WITH NUT ALREADY AFFIXED. All finishes—any size for cable, conduit and pipe.

Fig. 465

Fig. 485

PAINE Clamps for Conduit, Cable and Pipe

The Handiest Thing in the Work Kit

Fig.500A

PERFORATED HANGER IRON

Fig. 500

Supplied in Any Metal, Any Finish, Any Gauge, Width and Perforation.

The Electrical Worker finds constant use for this sensible, time-saving dependable item. Extremely adaptable to fit any space requirement. Precision made without burrs or rough edges. Supplied in strip or coil: Copper or steel; Black, galv. or Cad. Plate. 5 and 10 foot lengths.

PAINE Perforated Metal Extension Tape

SEND TODAY for the NEW PAINE CATALOG

CONDUIT

ARMORED CABLE

LOOM

Exclusive and Patented Features

Approved by Underwriters' Laboratory. Gangable. Supplied in many sizes and styles. Clamps out of way for easy insertion of cable. Openings visible for Anti-Short Bushings. Sides quickly snapped together or pried apart.

PAINE

Sectional Gangable Switch Boxes

Branches in:
Los Angeles, Cal.
Dallas, Texas
Atlanta, Ga.
Norfolk, Va.
Pittsburgh, Pa.
Denver, Colo.
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PAINE — 1912 ANCHORS HANGERS 1939 — *Superior Feature* BUILDERS SPECIALTIES

Factory and Main Office:
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FOR NON-METALLIC SURFACE WIRING

Specify SURFOLETS FOR GREATER

SAFETY • PERMANENCE • ECONOMY

Modern Surface Wiring Demands Surfolets

No. 8460
Pull Chain Lamp Base

SURFOLETS were designed to meet the urgent demand for safer, more permanent and more economical surface wiring devices for use with non-metallic wiring.

SURFOLETS provide the safety and permanence that only rugged everlasting all-porcelain construction can give.

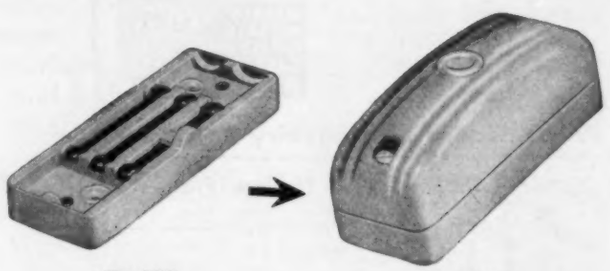
SURFOLETS higher economy lies in the fact that they require no clamps, no connectors, no grounding, are quickly and easily installed and that one *standard interchangeable base* suffices for the complete line of SURFOLETS surface wiring devices.

SURFOLETS in Rural wiring where danger of exposure to dampness is of vital importance, are meeting with exceptional approval and enthusiasm.

Safety + Permanence + Economy + Appearance = SURFOLETS
Therefore, when planning your job or stocking up—specify SURFOLETS.

Write at once for your copy of the SURFOLET folder for complete information.

PORCELAIN PRODUCTS, INC.
Findlay, Ohio

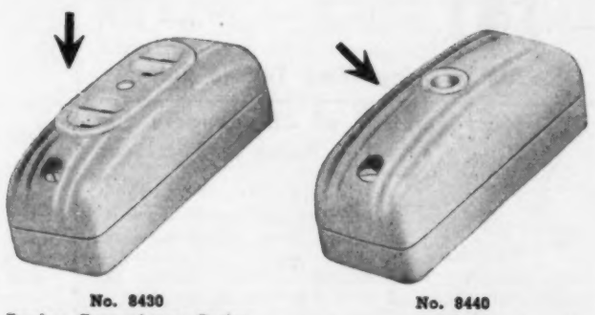


No. 8400
Uni-Base Only

No. 8450
Blank

No. 8410 Single Pole
Tumbler Switch
Feed Through Dead End
Three Way No. 8415

No. 8420
Keyless Lamp Base



No. 8430
Duplex Convenience Outlet

No. 8440
Pendent

PORCELETS

PREFERRED FOR SAFER WIRING

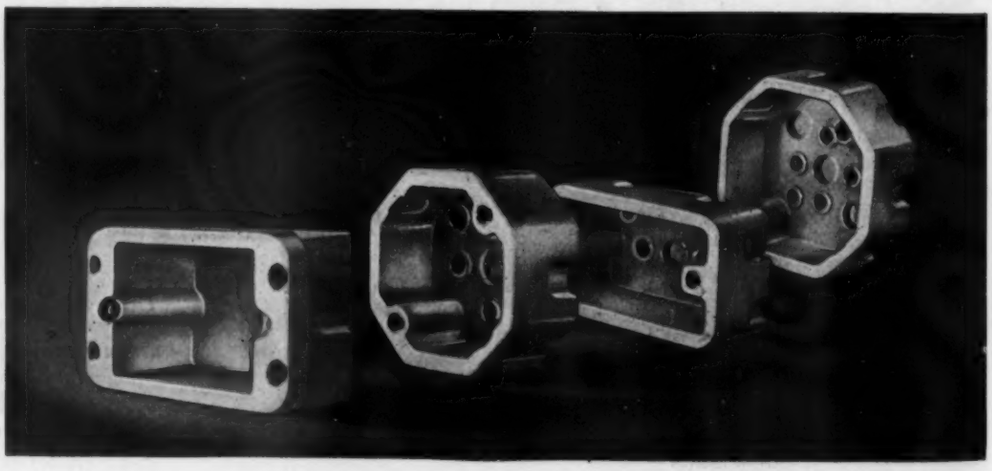
Porcelain Outlet Boxes, commonly known at PORCELETS, have set a new standard of safety in non-metallic wiring in installations where special hazards exist, especially such as are found in Rural work, farm buildings, and out buildings, farm homes and dairies.

PORCELETS are also especially useful in any damp location or where fumes are encountered, such as warehouses, packing houses, breweries, chemical plants and many other industrial houses.

PORCELETS' boxes and covers are furnished in standard shapes and sizes with standard tapped inserts, standard knockouts and spacing to receive standard devices.

Porcelain Outlet Boxes are economical because they require no grounding and no Clamps or Connectors.

Write for our new catalog No. 16, featuring our complete line.



Porcelain Products, Inc.
Findlay, Ohio

QUAD

The Quad line of porcelain enameled reflectors is well known for its high quality of material and workmanship as well as the range of equipment offered.

Representative material listed on this page includes several items certified by the Electrical Testing Laboratories of New York as complying with standard specifications of the RLM Standards Institute. Such certification is an additional assurance of quality.

The line also includes "economy reflectors" of good commercial grade. Prices quoted on application.

Sold through Electrical Wholesalers

Glassteel Diffusers

Safety Type

Made in two sizes for lamps up to 500 watts with opal and Trutint (daylight) glass.

RLM Standard Dome

Socket Type

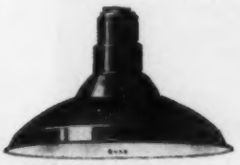
Socket Type for ½" or ¾" pipe. Six sizes for lamps up to 1,000 watts. Fitter type for lamps up to 200 watts, also made with shadeholders attached.

RLM Deep Bowl

Deep Bowl

Other Standard Shapes

Flat Cone



Shallow Bowl

Each of the above styles is made in socket and fitter types and with shadeholders for brass, porcelain and W.P. threaded sockets. Socket Reflectors are tapped for ½" or ¾" pipe and made for lamps up to 500 watts, 2¼" Fitter types for lamps up to 200 watts.

Q-D Reflectors and Socket Fittings

Special Dome

Type B

Socket Fitting for Outlet Box Mounting

Shallow Bowl

Reflectors shown have Type "V" vertical fitting for ½" pipe which is interchangeable with type "B" (center) or Type "H" shown on sign reflectors above to right. The Special Dome is made in five sizes up to 500 watts and the Shallow Bowl in four sizes up to 200 watts.

Dome Reflector For Mercury Vapor

Porcelain enameled green outside, white inside. Designed for the 400 watt high intensity mercury vapor lamp. Recommended for general industrial illumination. Its wide distribution characteristics combined with the shielding effect of the deep skirted reflector and opal glass diffusing ring make this a most practical unit for comparatively low mounting.

Post Top Reflector

Designed for the general illumination of outdoor locations where a practical fixture of good appearance is important. The unit consists of a green porcelain enameled reflector white inside, with ornamental knob, attached to an urn shaped cast aluminum socket housing by means of heavy cadmium plated iron rods. Three sizes of reflectors accommodate lamps from 200 watts to 1500 watt capacity.

RLM Silvered Bowl Diffuser

The Quad Silvered Bowl Diffuser is made in the solid neck socket-reflector construction for 300 or 500 watt silvered bowl lamp. Reflector is porcelain enameled white inside and outside with an inner reflector of Alzak aluminum. Socket fitting is cast brass with exterior locknut of cast aluminum. Regularly furnished tapped at top for ½ inch conduit or for ¾ inch when specified.

Duplex Dome

Made in three sizes for lamps up to 500 watts with solid neck or threaded socket-hood construction. Reflector delivers sufficient light upward to relieve ceiling contract and when used with the bowl enameled lamp glare is practically eliminated. Porcelain enameled white inside and outside.

Elliptical Angle Reflector

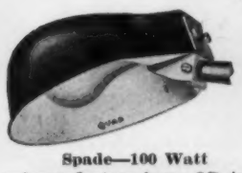
Made in QD socket type for lamps up to 1500 watts and in solid neck construction up to 200 watts.

Dust Tight Glass Cover

Covers are made in plain clear glass, daylight blue and heat resisting glass. Sizes range from 8" to 20" complete with impregnated felt gasket and cadmium plated ring for clamping to rim of reflecor.

Sign Lighting Reflectors

Rectangular Type H

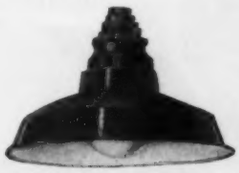


Spade—100 Watt

Round Angle Type H

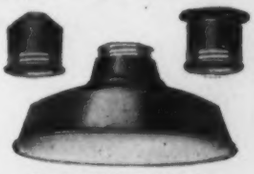
Round and Rectangular reflectors have QD interchangeable sockets to take lamps up to 500 and 1000 watts respectively. Both Spade and Rectangular reflectors provide straight line light cut-off at top of sign.

Vaporproof Fixtures



A complete line of fixtures with and without reflectors. Made with dome, angle, shallow bowl and deep bowl reflectors with outlet box, vertical pendant or horizontal pipe fittings.

Heavy Threaded Reflectors



Removable Reflectors

RLM Dome shown includes sizes up to 1000 watts. Also made in shallow bowl, deep bowl and angle shapes up to 500 watts with threaded socket hoods.

Open Type Floodlights

With bracket for Open-Wiring—Can be mounted on 1½" to 2½" iron pipe, or on walls, wood poles or cross-arms.

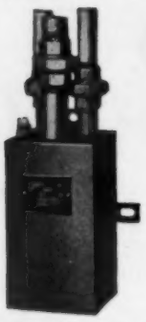
This series of larger Quad Floodlights, made for the 750, 1000, 1500 watt lamps is adapted to all outdoor lighting where the maximum of diffuse light and wide angle light distribution are essential.

Floodlights have interchangeable auxiliary reflectors for beam control, note medium beam projector (left above) and long beam projector (right above). Lamp sizes range from 300 watts to 1500 watts. Multiple mounting brackets permit arrangements in banks of two, three or more.

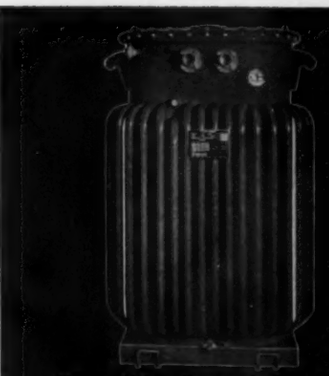
QUADRANGLE MANUFACTURING CO.

30 S. Peoria St. **Chicago, Illinois**

Type A — Conventional Distribution Transformer.



Type SS-1 Series — Series Street Light Transformer with primary & secondary detachable couplings.



Type HS — Pyranol Cooled Subway Transformer.

Type MC—Dry Type Transformer for indoor or outdoor service. Manufactured in sizes 1 to 10 KVA.

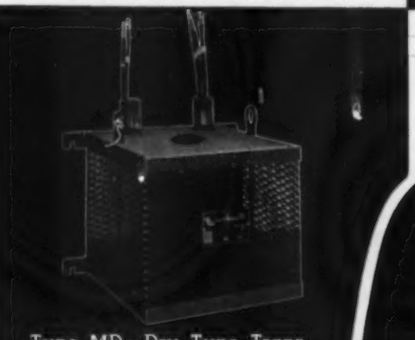
Standard

TRANSFORMERS

for Every Class of Service

For a complete description of the design and construction used in the manufacture of each type of transformer, refer to the bulletins listed below.

Type HV—Test Set for high potential testing.



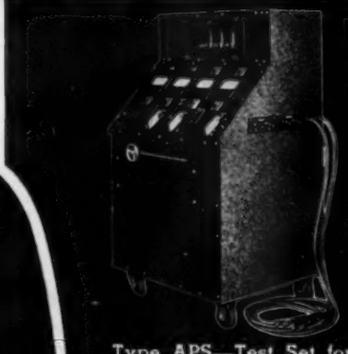
Type MD—Dry Type Transformer for indoor service. Manufactured in sizes 3 to 50 KVA.

THE STANDARD TRANSFORMER CO.

Manufacturers

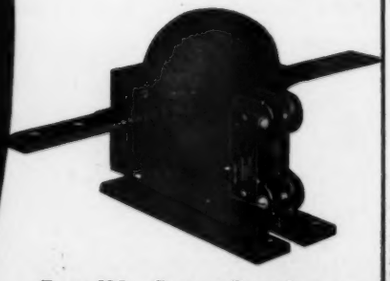
WARREN, OHIO, U. S. A.

Type A—2000 KVA Power Transformer.



Type APS—Test Set for the complete testing of alternating current equipment.

Type P—Potential Transformer with primary submergible fuses —for indoor service.



Type NA—Current Transformer for extremely accurate metering service.

SIGNALLING TRANSFORMERS ..... No. S-100
PYRANOL COOLED TRANSFORMERS ..... No. S-101
DRY TYPE TRANSFORMERS No. S-201

RURAL TRANSFORMERS .. No. S-301
DISTRIBUTION AND POWER TRANSFORMERS ..... No. S-401

CURRENT AND POTENTIAL TRANSFORMERS ..... No. S-501
TESTING TRANSFORMERS No. S-601
STREET LIGHTING TRANSFORMERS ..... No. S-701

the PROFIT is yours FOR KEEPS

WHEN YOU INSTALL A SANGAMO TIME-SWITCH

Offer Form KAZ to your customers. They will prefer this modern, popular-priced Sangamo Astronomic Time-Switch.

By insisting on "Sangamo" you get this low-speed, 240 R.P.M., high torque, self-starting motor in every synchronous switch.

BREAKDOWN TEST AT 10 TIMES RATED VOLTAGE

Part of the inspection routine of each Sangamo Time-Switch is a motor-insulation breakdown test at 10 times rated operating voltage. This and many other exhaustive tests, together with the inherently superior design of Sangamo Time-Switches, assure that you won't have to make a service call later—that the profit is yours *for keeps* when you install a Sangamo Time-Switch.

SANGAMO
ELECTRIC COMPANY
SPRINGFIELD · ILLINOIS

IT MUST BE RIGHT

smooth sailing with TRIANGLE

TRIANGLE PRODUCTS GO PLACES

Specify!

TRIANGLE RIGID CONDUIT

HOT DIP GALVANIZED!

Plus A Baked-On Lacquer Finish!

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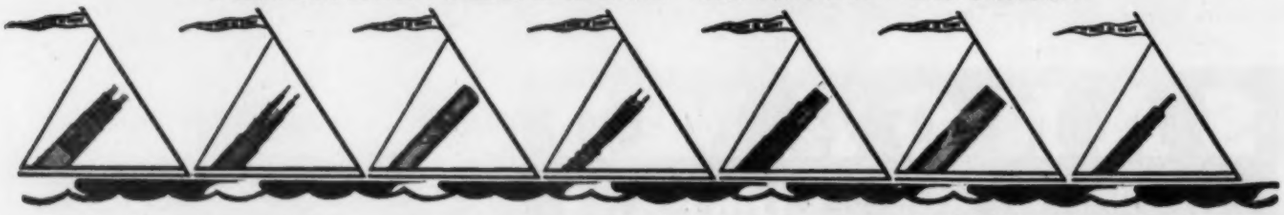


TRIANGLE CONDUIT & CABLE COMPANY, INC.

Horace Harding and Queens Blvds.
Elmhurst, New York City, N. Y.

Select a Wagner Motor

and be sure of getting the Right motor for the job

Wagner motors are built in such a wide range of mechanical and electrical types that with few exceptions you can select a motor from the Wagner line that exactly meets the requirements of the job. The importance of selecting a motor of the correct horsepower is, of course, obvious, and mistakes are seldom made in this respect. However, horsepower is only one of many things to consider in choosing a motor for a particular application. The selection of the right type of motor is a task that should be delegated to the manufacturer, jobber or dealer specializing in motors. Wagner recommends the consultation of authorities on that subject.

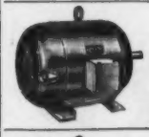
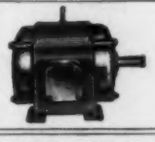
Table of 7 Electrical Types of Wagner Polyphase Squirrel-Cage Motors

Type	Standard Ratings* (Single-Speed)†	Locked-Torque**	App. Full-load Slip	Typical Applications
RP1	1/10 to 400 hp 3 or 2 phase 25 to 60 cycles 110 to 2200 volts	Varies with the square of the voltage applied to the motor terminals: approximately 150% of full-load torque at rated voltage; 96% at 80% voltage; as low as 38% at 50% rated voltage.	3 to 5%	Group or individual drives, in machine shops, on machine tools, fans and blowers, compressors, centrifugal pumps—on any application where normal-torque motors are satisfactory.
RP2	7½ to 200 hp 3 or 2 phase 60 cycles 110 to 2200 volts	Approximately same as RP1 motors. As these motors can be started across the line at **rated** voltage, they can start considerably more load than RP1 motors started under **reduced** voltage.	3 to 5%	Same as standard squirrel-cage motors, type RP1.
RP3	40 to 100 hp 3 or 2 phase 60 cycles 220 to 2200 volts	Centrifugal pump service does not require heavy starting-torque. Therefore these motors have starting torque of 80% to 100% of full-load torque.	3 to 5%	Centrifugal pumps, agitators, fans and blowers, generator sets, and other applications requiring low starting-torque.
RP4	1½ to 30 hp 3 or 2 phase 60 cycles 110 to 2200 volts	About 200% to 250% of full-load torque.	3 to 5%	Crushers, plunger pumps, belt conveyors starting under load, large air compressors, large refrigerating machinery, mixers, and other applications requiring high starting-torque.
RP5	40 to 100 hp 3 or 2 phase 60 cycles 220 to 2200 volts	Varies with the square of the voltage applied to the motor terminals: approximately 200% to 250% of full-load torque at rated voltage; 130% to 160% at 80% voltage; 85% to 106% at 65% rated voltage.	3 to 5%	The logical motor to use for applications where the torque produced by RP1 motors is not sufficient. If the starting-torque of Type RP5 motors under reduced voltage is too low for any application, Wagner slip-ring or Fynn Weichsel motors should be used.
RP6	½ to 150 hp 3 or 2 phase 25 to 60 cycles 110 to 2200 volts	About 300% to 350% of full-load torque.	7 to 12%	Punch presses, shears, bulldozers, metal-drawing operations, balers, and other machinery equipped with flywheels or having flywheel effect.
RP7	1 to 50 hp 3 or 2 phase 25 to 60 cycles 110 to 550 volts	Approximately 250% of full-load torque.	15 to 17%	Elevators, cranes, hoists, dumbwaiters.

*In addition to ratings listed, Wagner builds special-frequency and special-voltage motors as special apparatus.

†These seven types are also available in 2, 3 or 4 speeds.
**All percentages given are for 4-pole, 60-cycle motors only.

Standard Mechanical Variations of the Above 7 Electrical Types

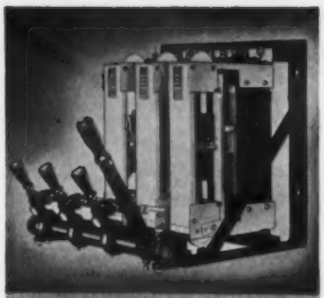
TYPE	DESCRIPTION	SIZES	TYPE	DESCRIPTION	SIZES
RP	Open — Ventilated	1/10 to 400 hp 2 or 3 phase 25 to 60 cycles 110 to 2200 volts	TP	Totally-Enclosed Not Ventilated	¼ to 15 hp 2 or 3 phase 25 to 60 cycles 110 to 550 volts
CP	 Totally-Enclosed Fan-Cooled	1½ to 125 hp 2 or 3 phase 25 to 60 cycles 110 to 2200 volts	DP	Drip-Proof	¼ to 5 hp 2 or 3 phase 25 to 60 cycles 110 to 550 volts
HP	Explosion-Proof	¾ to 125 hp 2 or 3 phase 25 to 60 cycles 220, 440 or 550 volts	XP	 Splash-Proof	¾ to 50 hp 2 or 3 phase 25 to 60 cycles 110 to 550 volts

The above tables cover Wagner polyphase squirrel-cage motors only. In addition, Wagner manufactures a complete line of single-phase, direct-current, slip-ring, and synchronous motors. No matter what type or size of motor is involved, there's a Wagner motor ideally suited for the job. The complete line of Wagner single-phase and polyphase motors is fully described in 52-page Bulletin 177 on fractional horsepower single-phase and polyphase motors, 70-page Bulletin 182 on integral polyphase motors, and 18-page Bulletin 179 on integral single-phase motors—sent free upon request.

M35-7

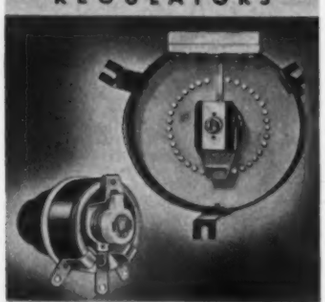
Wagner Electric Corporation

6400 Plymouth Avenue, Saint Louis, Mo., U. S. A.



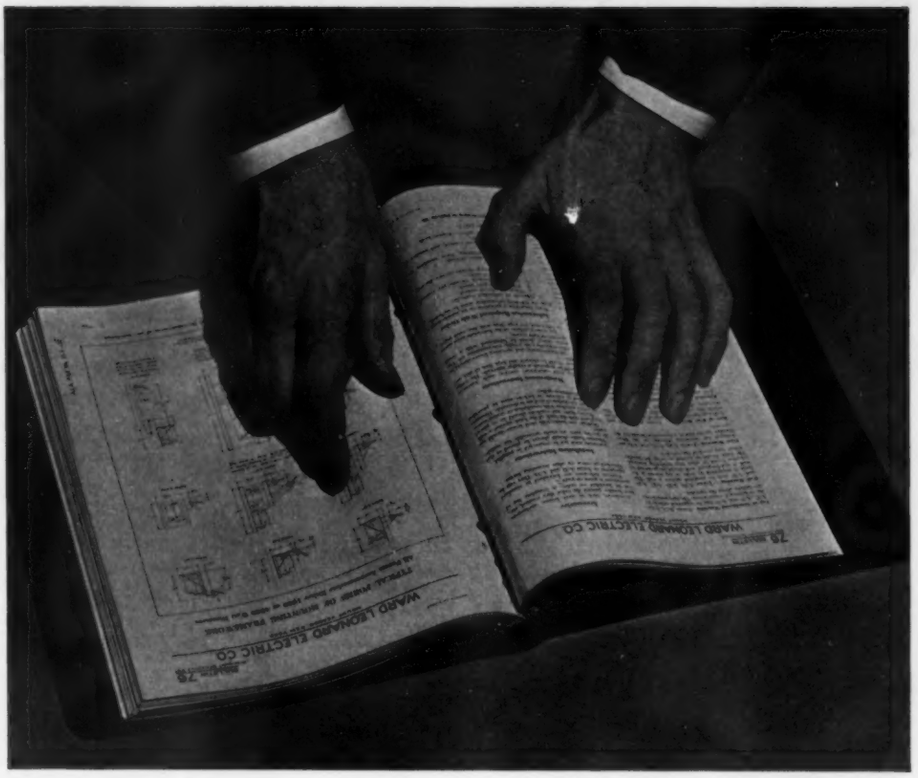
DIMMERS

VOLTAGE REGULATORS



RHEOSTATS

RELAYS



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. . . the market is wide open . . . the demand exists . . . and these sales helps are available.

With this assortment of sales helps you can develop Teletalk business in your community.

Teletalk is an ideal item for you—the electrical contractor. Every time you sell Teletalk inter-communication, you sell wire, conduit, junction boxes, and other supplies—plus labor for the installation. And Teletalk can be sold practically everywhere. Two station systems for retail stores and small business offices can be sold as low as $49.00. Other systems, running into the hundreds of dollars, can be sold to local industrial plants. No other inter-communication system is so flexible, so adaptable, so low in price, or so acceptable to the buyer. Teletalk is available in five basic models, four speaker-microphone units, and two circuits. Ask your Graybar salesman to demonstrate it for you, show you how and where you can sell it with profit, or write direct for literature.

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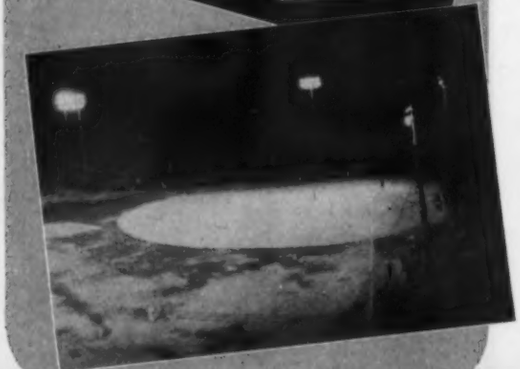
SPECIFY . . .
Westinghouse FLOODLIGHTING



Because satisfactory floodlighting of outdoor areas demands much more than the mere installation of lighting units, specifications must be carefully written. The provision of efficient and adequate illumination of proper direction, with no objectionable glare, constitutes an individual problem in almost every instance.

A staff of skilled Westinghouse floodlighting engineers is at your service without charge to assist with lighting layouts and recommendations. Call on these men, and, at the same time, ask for details on the complete line of Westinghouse floodlights.

PROTECTIVE LIGHTING . . . Night protection afforded industry by floodlighting is a vital factor in reducing malicious property damage, minimizing personal injury and increasing efficiency of outdoor night work. Westinghouse CAK Floodlights are heavy-duty lighting units ideal for permanent installations and severe service conditions.

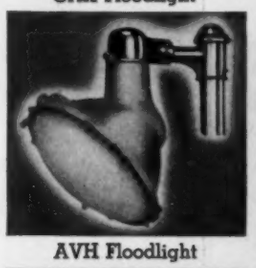
SERVICE STATION LIGHTING . . . Westinghouse engineers have designed floodlights that set off service station facilities to utmost advantage. Westinghouse AVH Floodlights are lightweight units that have cast-aluminum hinged doors to simplify maintenance and servicing. These floodlights are used widely with either mercury or incandescent lamps.

SPORTSFIELD FLOODLIGHTING . . . "Play after dark" is influencing more and more schools, municipalities, industries, and professional groups to floodlight for night sports. Westinghouse AFA Floodlights, open-type, porcelain enameled units with inner aluminum reflectors finished by the Alzak process, are especially well suited for all types of sports.

UNDERWATER FLOODLIGHTING . . . Westinghouse provides a line of underwater floodlights for all types of pools and fountains. The new Aqualux CS-10 Underwater Floodlight is a 500-watt unit that, like all Westinghouse Aqualux units, is sealed by a special thermo-pressure treatment which eliminates need for a breather or a drainage tube.

For complete details, call your local Westinghouse distributor; or address Westinghouse Electric & Mfg. Co., Lighting Division, Edgewater Park, Cleveland, Ohio.

CAK Floodlight

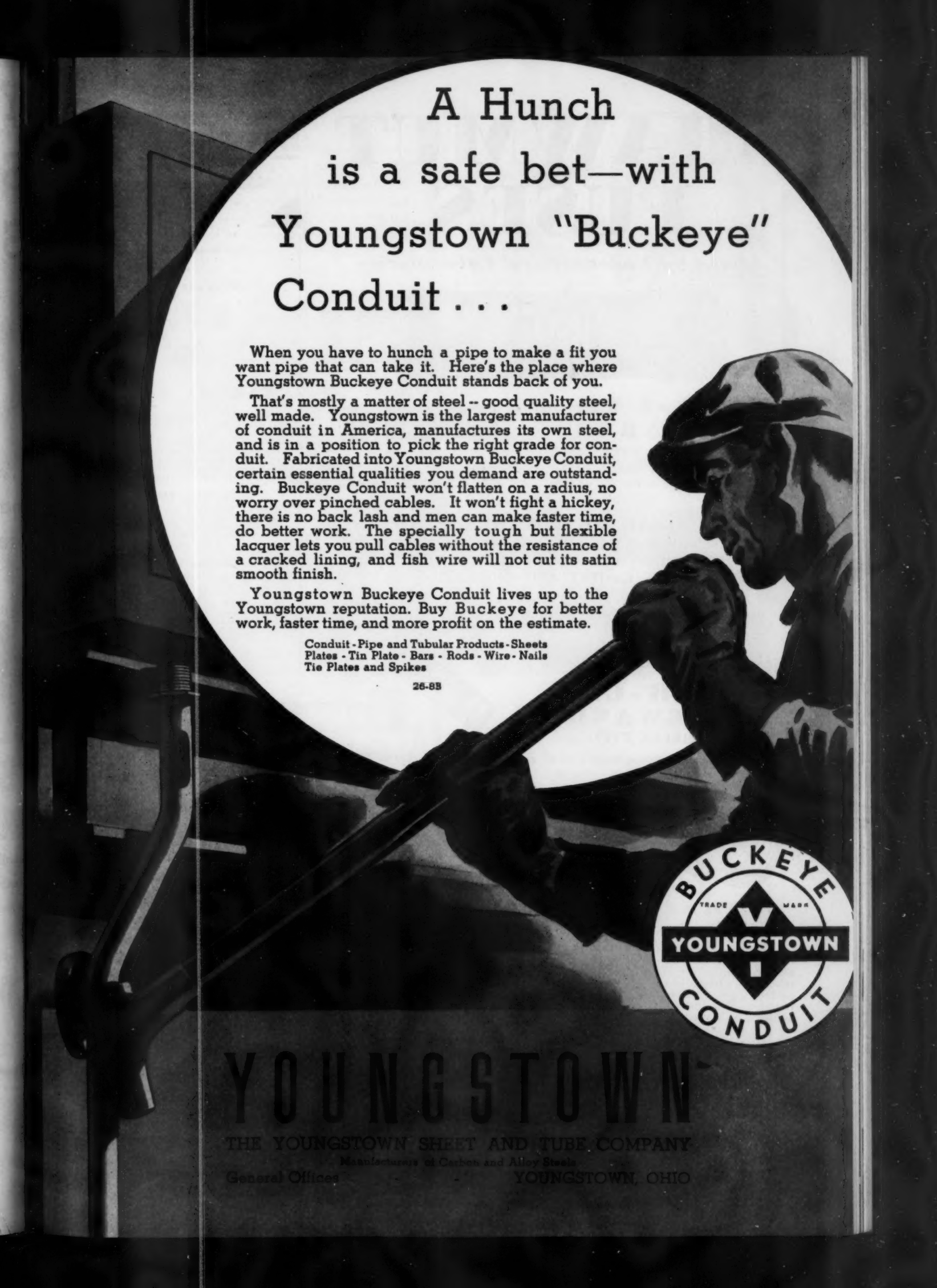


AVH Floodlight

AFA Floodlight

CS-10 Aqualux

Westinghouse Lighting Equipment


A Hunch
is a safe bet—with
Youngstown "Buckeye"
Conduit . . .
When you have to hunch a pipe to make a fit you want pipe that can take it. Here's the place where Youngstown Buckeye Conduit stands back of you.
That's mostly a matter of steel -- good quality steel, well made. Youngstown is the largest manufacturer of conduit in America, manufactures its own steel, and is in a position to pick the right grade for conduit. Fabricated into Youngstown Buckeye Conduit, certain essential qualities you demand are outstanding. Buckeye Conduit won't flatten on a radius, no worry over pinched cables. It won't fight a hickey, there is no back lash and men can make faster time, do better work. The specially tough but flexible lacquer lets you pull cables without the resistance of a cracked lining, and fish wire will not cut its satin smooth finish.
Youngstown Buckeye Conduit lives up to the Youngstown reputation. Buy Buckeye for better work, faster time, and more profit on the estimate.
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Plates - Tin Plate - Bars - Rods - Wire - Nails
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THE YOUNGSTOWN SHEET AND TUBE COMPANY
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SHAWMUT FUSES

Listed by Underwriters' Laboratories

SHUR-LAG RENEWABLE
(KNIFE-BLADE TYPE)

In seventeen different ratings, from 70 to 600 amperes, for either 250 or 600 volts.

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IN BOTH THE KNIFE-BLADE AND THE FERRULE TYPE, ARE THE SIMPLEST AND STURDIEST TIME-DELAY FUSES MADE, AND THE EASIEST AND QUICKEST TO RENEW

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PLUG FUSES

The original fuse so marked that a clear ampere rating is always readable. Link gives positive and unfailing indication whether fuse is intact or blown.

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(*Fuses with thermal cutout*)

Provide time-delay. The simplest, surest, most economical protection for motor circuits. Plainly indicate when blown.

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Fuse makers since 1893

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from
The Most Varied Line
of
INTERVAL TIMERS
TIME SWITCHES
FLASHERS

INTERVAL TIMERS

INTERVAL TIMERS, or PROCESS TIMERS, are furnished in two types. One is reset by hand (manually); other resets itself automatically. Both types can be provided for practically any cycle of time, fully adjustable from zero to maximum period. SYNCHRONOUS, SELF-STARTING MOTORS.

MANUAL RESET

Turning Indicating Hand on dial, to any point desired, automatically starts Timer. When hand reaches "0", Timer will perform any function specified, and shut itself off. List prices from $18.50 up.

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Pressing a monetary-contact push-button starts Timer in operation. At end of interval for which it is set, Timer will perform the specified action, shut itself off, and automatically re-cycle to starting position, ready for next operation. Can also be furnished for automatically continuous action. Interval timed can be reset at any time as desired. List prices range from $30 to $45.

SIGNAL TIMERS
or
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Used extensively for starting and stopping industrial work; school class periods; for municipal time signals, etc. Up to six signal periods, permanently set at factory with Sunday & Holiday Cutout and Manual Control, at a list price of only $35.

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TRIPLE POLE
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SINGLE POLE

All three types can be furnished with capacities ranging from 20 TO 200 AMPERES PER POLE, listing from $16.50 up. Ten ampere Time Switches from $4.95 up.

WRITE TO

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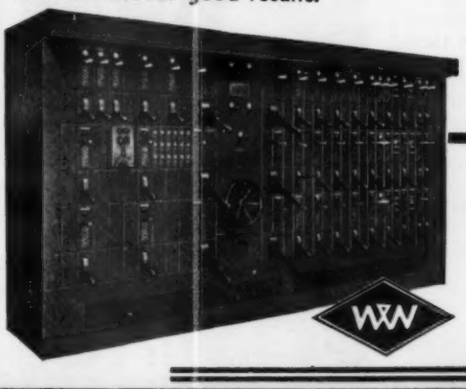
ELECTRIC MFG. CO.
Mankato Minnesota

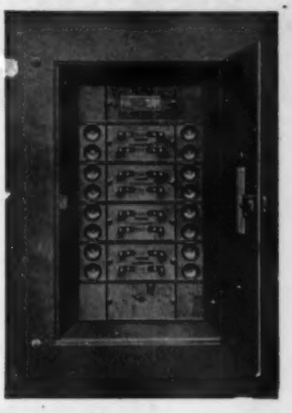
WURDACK EQUIPMENT . . . . .

is making money right along for Contractors. There's always the right size and design, no matter what the job may be. The complete line includes panelboards, circuit breaker panels, distribution panelboards, and remote control stage switchboards. Simple design and rugged construction give you finished work that establishes a sound reputation, and satisfied customers are the best recommendation. Depend on WURDACK for good results.



WURDACK PANELBOARDS

a complete line of Dead Front Lighting Panelboards, constructed of standardized sections of moulded Bakelite. All switches and fuse receptacles are readily removable from front of panel. All Cabinets made of Code Gauge Galvanized Steel. Fronts of full finished cold rolled steel, rust-proofed with gray lacquered finish.



WURDACK REMOTE CONTROL STAGE SWITCHBOARDS

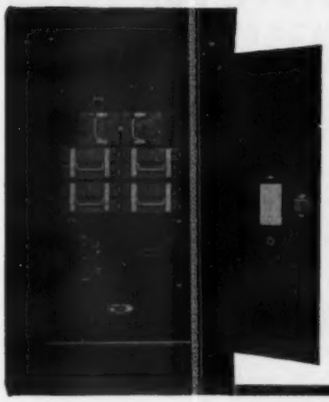
designed for all types of Theatres, Auditoriums, Fraternal Buildings, and Schools where a modern system of lighting control is desired. Outstanding features are simplicity of design, convenience of arrangement, and ruggedness of construction. Each installation is carefully engineered to meet its particular requirements.

When you install

WURDACK EQUIPMENT

you insure a modern job . . .

★ THE UTMOST IN CONVENIENCE
★ COMPLETE DEPENDABILITY
★ ALL AROUND SATISFACTION

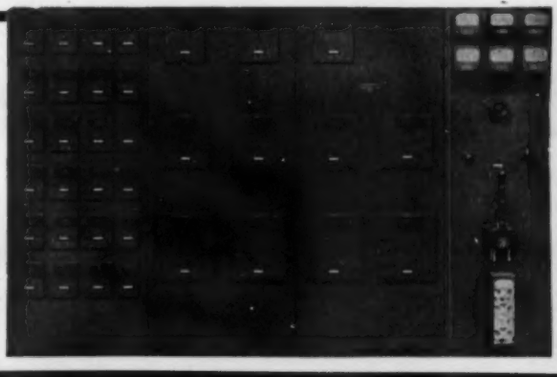


Wurdack Dead Front Feeder or Distribution Panelboards

are constructed of individual units of moulded Bakelite of the pull-out type up to 100 ampere inclusive. Circuits of 200 amperes and over are equipped with Auto Shift Switch Units. All units are convertible downward.

WURDACK DEADFRONT SWITCHBOARDS

of the Auto Shift Type are constructed of cold rolled steel panels with opening cut for individual Auto Shift Switch Units. These units are so constructed that all parts are dead when door is open. Fuses are mounted on insulated bases on back of steel inclosures, eliminating all heavy parts from door.



★ For results that are always right—for easy installation —for dependability in service—WURDACK Equipment is the answer. Get details.

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SALES OFFICES IN PRINCIPAL CITIES

MORE EFFICIENT ILLUMINATION

Plus Greater Decorative Appeal

FOR COMMERCIAL INSTALLATIONS

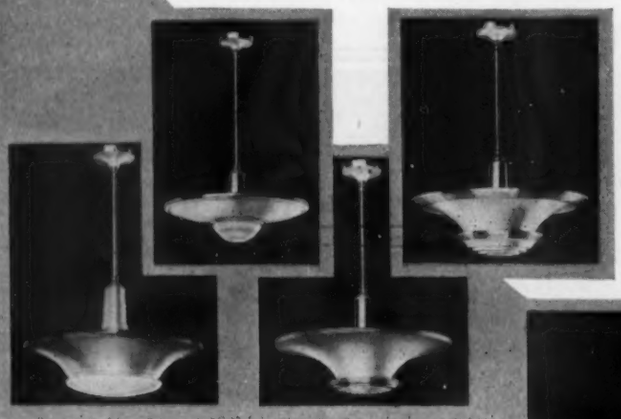
with

ART METAL *Fixtures*

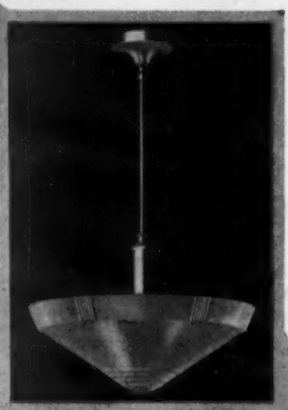
(LABORATORY TESTED)

Always mindful of the need for a finer type of commercial illumination, Art Metal offers you lighting creations that combine the three essentials of good lighting . . . adequate illumination, avoidance of glare, and avoidance of too great contrast in light and dark spots . . . with simplicity of design and smart styling that make interiors more appealing. With Art Metal fixtures you can be sure of the most efficient light intensity for all the widely divergent commercial services, such as found in auditoriums, showrooms, shops, offices, schools, libraries, banks, and clubs.

Our Engineering services are available at all times . . . We can help solve your lighting problems . . . E.T.L. curves available on request.



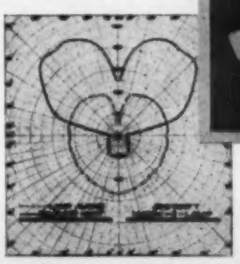
Here are shown a few outstanding items that are especially efficient and appealing in commercial use. More specialized fixtures, however, are included in the line.



. . . and the PLASTICLITE

THE FINEST IN PLASTIC BOWL DESIGN

1. Light in weight
2. Resilient and strong
3. Reduced breakage . . . non-shatterable
4. Off-white color—the restful tone
5. Transmits light without glare — maximum surface brightness (500 W) 1.4 candles per sq. inch
6. Overall efficiency (E.T.L. test) 82.5% with baffle concealing lamp neck
7. Low maintenance cost
8. Wide light distribution
9. Extremely high output
10. Good low cost lighting
11. Molded to Art Metal specifications by G.E.



Some indication as to the effective light distribution afforded by the PLASTICLITE is shown opposite. Get details!

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NO MORE

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- WASTED MOTIONS
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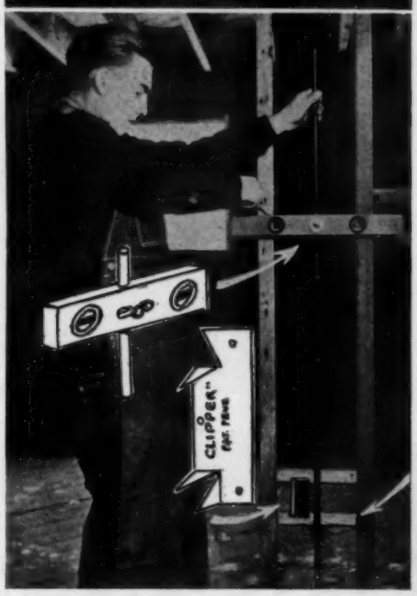

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"CLIPPER"

OUTLET BOX SUPPORT & ELECTRICIAN'S GUIDE

Here's QUICKER, EASIER and LESS COSTLY INSTALLATION. EXAMINE the advantages of this method:

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- EASIER WIRE PULLING

"ELECTRICTUBE"

Electrical Metallic Tubing is coated on the outside with a substantial amount of zinc evenly deposited by electro-plating process to stand severe corrosive conditions. Interior surface is coated with an enamel especially developed by us, which is impervious to acid and insures a perfect raceway for pulling wires. Can be used with any standard light wall fittings.

Connectors and couplings to be used with ELECTRICTUBE can be furnished from stock.

"GALVAKOTE"

Exterior surface and threads coated with zinc evenly deposited by electro-plating process in quantity to withstand more than four dips of Preece test in regulation copper sulphate solution. Interior furnished coated with the best quality black enamel.

"ENAMELKOTE"

Coated inside and outside with high-grade black enamel, properly baked in modern ovens to insure adhesion to pipe wall, and sufficient flexibility to prevent flaking in bending.

"HOTKOTE"

Exterior and interior surfaces evenly coated by the hot galvanized process and then covered inside and outside with a coat of transparent enamel.

"Hotkote" Nipples

Underwriters' Laboratories Approved

These rigid conduit nipples are also approved by the Underwriters' Laboratories and so labeled. All threads are protected with a special coating that is rust resisting.

Distributed everywhere by leading wholesalers.

CLAYTON MARK & COMPANY

EVANSTON — ILLINOIS

MANUFACTURERS FOR MORE THAN A THIRD OF A CENTURY.

ENGINEERED ILLUMINATION FOR THE HOME . . .

with

ART METAL *(LABORATORY TESTED)* *Fixtures*

For home lighting conditions, "There must be enough light and it must come from the right direction." Light for *seeing* . . . and the easiest way to get it is with Art Metal Engineered lighting fixtures! Embodying the essentials for good light conditioning, they also provide that touch of decoration and finesse to keynote the artistic temperament of any interior.

Art Metal Fixtures are laboratory tested to provide the *correct* light for every type of home service . . . they bring out the beauty and color of the room and are styled to complement any decorative scheme. Our new booklet, *"Fashions in Lighting"*, describes in detail the "whys" and "wherefores" of engineered illumination and how it can make a house a *home*. Send for free copy today.

The fixtures illustrated above are typical of Art Metal lighting creations which, while embodying scientific features for better seeing, are more than utilitarian . . . they actually add to the charm of the home.

FREE

this booklet will help you visualize the benefits of "engineered light conditioning" with Art Metal fixtures. A copy will be sent on request without obligating you in any way!

SEND ME "FASHIONS IN LIGHTING"

THE ART METAL COMPANY, Cleveland, Ohio.

Please send me free copy of Booklet R-240.

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by Couch

ESTABLISHED 1894

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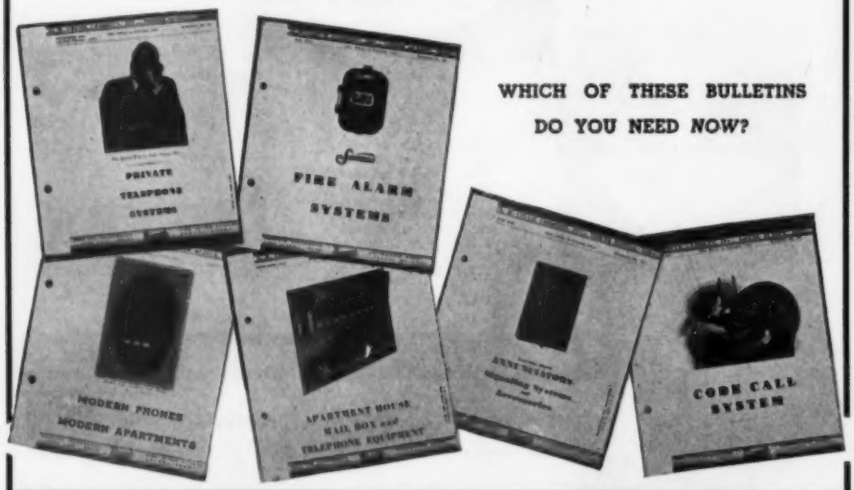
PRIVATE TELEPHONE SYSTEMS
FIRE ALARM SYSTEMS
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RE-MO-LITE is your best bet to make money on those Rural Electrification Projects, which are going on all over the country. Newly developed and perfected to give you simplicity and speed in wiring and yet giving tops in profit.

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Low Cost Onan Alternating Current Electric Plants Installed to stand by in case of such Emergencies supply Electricity while Power is down and allow Business to go on as usual.

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12-32 and 110 volt, D.C.—110 or 220 volt A.C. Also Combination AC-DC Units. Immediate shipment.

COMPLETE—READY TO RUN

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WILSON LIGHTING INC.

Distinctive Patented Lighting Equipment

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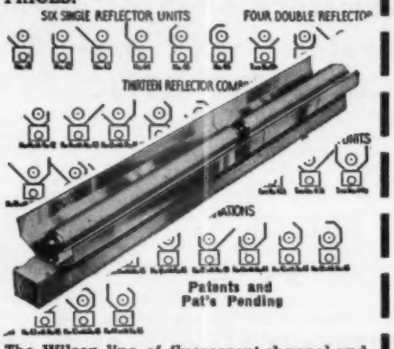
The Only COMPLETE Line Of

FLEUR-O-LIER

Fluorescent
Wiring Channel • Fixtures
Combinational Reflectors

• *Easier to wire* • *Easier to install*
• *New, exclusive positive-locking covers*

PLUS 23 DIFFERENT REFLECTOR COMBINATIONS CARRIED IN STOCK FOR IMMEDIATE DELIVERY. CUSTOM-BUILT QUALITY AT QUANTITY PRICES.



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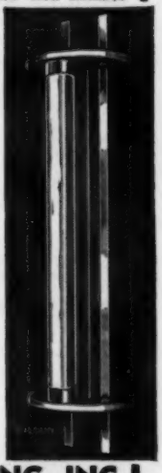
Fluorescent Industrial Fixtures

Individual 1-lamp, 2-lamp and 3-lamp fixtures complete with reflectors and fittings ready to install for commercial and industrial applications. (Not illustrated).



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Decorative Wall Bracket

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An unusually distinctive wall fixture for stores, lobbies, fitting rooms and other locations. Chrome plate and satin alumbronze, they attract a great deal of attention and do a fine lighting job. Contractor net price, $6.72 each wired with reactance ready to install. 15w. size.

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(Member Fleur-O-Lier Manufacturers)
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Also mfgrs. of lighting fixtures, recessed units, floodlights, show window reflectors, etc. Ask for prices and data.

Distributed only thru Electrical Wholesalers

Badger

and

RELIANCE MODEL W

Synchronous

ELECTRIC TIME SWITCHES
for real profit

High capacity—accuracy—economical operation—easy installation—these are some of the reasons that create a demand for the Reliance line of Time Switches. The very latest design and construction features embodied in the manufacture of our time switches offer innumerable exclusive features which speak in terms of more and profitable jobs. Contractors can wire them and forget them.

• Approved by Underwriters' Laboratories and guaranteed by us against defective material and workmanship.

"BADGER" TIME SWITCHES

Synchronous types are regularly furnished for 60 cycle, 110 volts, regulated alternating current, but switch may be connected to a three-wire circuit, switching the 250 volt line.

Two types available in the 8-day hand-wound construction for use on direct current.

The sheet steel case is especially furnished for installations free from extreme dampness and dust. Not gasketed or padlockable. Combination knockouts for ½ and ¾ inch conduit are furnished on the bottom and sides of the case. The cast iron case is fully gasketed, weatherproof and padlockable. Two holes are drilled in the bottom of the case for ¾ inch conduit. Size 5½ x 10½ x 4½ inches deep.

The 8-day types are powered by a heavy clock movement and are independent of current, voltage and continuous current supply. Both types are enclosed in the cast iron cases described above.

"BADGR" TIME SWITCHES

All types are single throw (straight " on " and " off ").

Type	Current	Poles	Capacity	Case
M1	60 cy. A.C.	1	All types rated	16 Ga. Stee
M2	60 cy. A.C.	2	at 30 am-	16 Ga. Stee
RM	60 cy. A.C.	1	peres, 125	Cast Iron
RM5	60 cy. A.C.	2	volts A.C.	Cast Iron
S1	A.C. or D.C.	1	each pole 30	Cast Iron
S2	A.C. or D.C.	2	amperes, 125 volts D.C. each pole.	Cast Iron

"RELIANCE MODEL W" TIME SWITCHES

An extremely simple, compact, economical and dependable time switch which, with only three types, covers practically every requirement.

Heavy silver contacts are rated at 30 amperes per pole at 125 volts. Case is of 18 gauge steel finished in black shrivel enamel. Combination knockouts for ½ and ¾ inch conduit are furnished at back, bottom and sides of case. Size 3½ x 7 x 4 inches deep.

In addition to the straight ON and OFF types, one type is built for the control of two circuits, giving six different combinations of two-circuit control by merely setting the trip hands for the desired sequence of operation.

"RELIANCE MODEL W" TIME SWITCHES

TYPE W-11—Single pole, Single throw,
TYPE W-22—Double pole, Single throw,
TYPE W-33—Double pole, Two circuit.

Write for complete catalog file

RELIANCE AUTOMATIC LIGHTING CO.

1907 MEAD ST. **RACINE WISC.**

The Sterling Engineering Staff IS AT YOUR SERVICE —

To Simplify ESTIMATING PROBLEMS

So many factors enter into modern sales illumination that Standardized Specifications are practically useless.

The type of store, lighting intensities in adjacent stores, height and depth of windows, as well as many other factors must be considered.

To help you give your merchant customers the last word in sales lighting efficiency, combined with operating economy, the Sterling Engineering Staff will supply layouts for each particular requirement.

Just send complete data on the job for prompt attention.

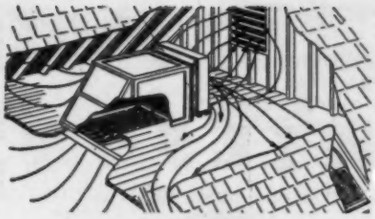
More Sales Power per watt! That's the marvelous achievement of Sterling Lite-Flo Reflectors that make merchants and display men open their eyes. *Write for brochure, "More Sales Punch with the Same Operating Cost."*

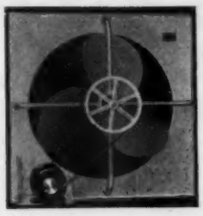
Ster-Lite Louver-Controlled Direct Lighting Units are revolutionizing store illumination. Incredible intensity on merchandise with diffused general illumination that's easy on the eyes. *Write for brochure of installations.*

Write for the Sterling Catalog

The Sterling Line includes equipment for Show Window Lighting, Store Lighting, Flood Lighting and General Interior Lighting. *Write for catalog.*

STERLING REFLECTOR CO.
1435 West Hubbard Street, CHICAGO





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★With these LOW COST units you can enter the highly profitable household summer comfort-cooling field. Every old or new home owner is a definite prospect and you do not have to be an air conditioning expert to cash-in-on COOLVENT!

Be first in your city to supply the demand for COOLVENT. New illustrated bulletin containing detail drawings, installation plans and PROFIT producing possibilities NOW READY. *Write today!*

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Member Nat'l Ass'n of Fan Mfgrs.

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IT CERTAINLY FITS THAT MOTOR!

● Having produced the major portion of all motor-starting capacitors now in use, AEROVOX knows best what type you need for any replacement. AEROVOX listings, in wall-chart and catalog forms, are kept right up to date. You can immediately select the RIGHT capacitor replacement for ANY standard motor. Ask your refrigerator-parts jobber about AEROVOX exact duplicate replacements —or write us direct.

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—include large and small sirens; motor driven, vibratory, and resonating horns; and electric air whistles; for fire alarm and call systems.

FEDERAL VERTICAL SIRENS

THE FEDERAL GENERAL ALARM SIREN is available in sizes ranging from 1 to 7½ horsepower. Its mighty roar is dependable under all conditions. Vertical sirens distribute sound equally in all directions. Rugged weatherproof construction with ample overload capacity assures many years of trouble-free service.

Type A

FEDERAL TYPE A SIREN

A fractional horsepower siren with extreme tone penetration. No gears or vibrating parts. Fully weatherproof for indoor or outdoor operation. Any specified voltage from 6 to 250. Write for bulletin 57.

FEDERAL Vibratory Horns

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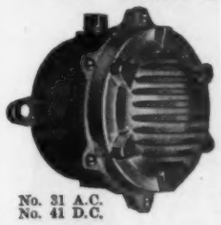

No. 31 A.C.
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FEDERAL HIGH POWER HORNS have twice the volume of ordinary vibratory horns. Ideal for unusually noisy locations. Available in either AC or DC for 110, 220 or 250 volts.

FEDERAL STANDARD HORNS provide ample sound volume for most applications in plants, yards, and warehouses. Available for any specified voltage from 6 to 250.

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Federal vibratory horns are made of non-corrodible material, each type being available in three styles. Ask for Industrial literature.

FEDERAL ELECTRIC COMPANY, INC.
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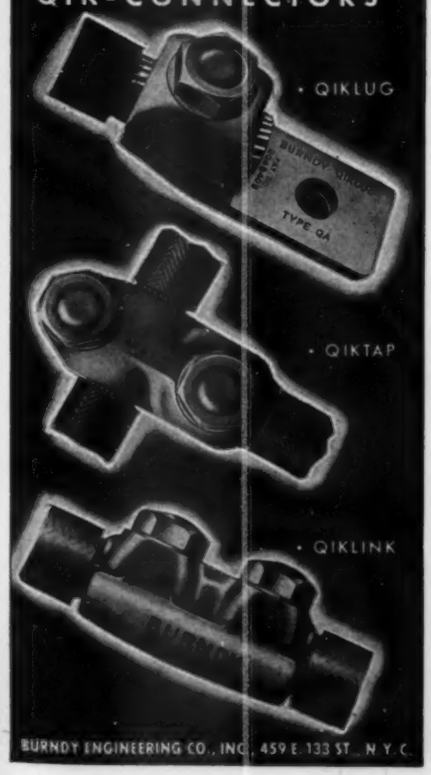


BURNDY ENGINEERING CO., INC., 459 E. 133 ST., N. Y. C.

. . . *and*

WHEN IT COMES TO TIME SWITCHES . . .

specify . . .

TORK

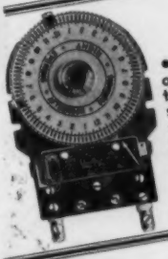
There are a thousand uses for time switches — you know them — from turning On-and-Off the lights in the village store window to handling the contactors that do the big jobs.

New Astronomic TORK CLOCKS are now following the sunlight in street lights, signs, and window lights.

Always you can rely upon TORK CLOCKS to do their jobs accurately and dependably. They are ruggedly and simply built and into each of them goes the experience gained in twenty years of time switch manufacture. They are easily set. They require a minimum of attention. So why not make them *standard* in every specification?

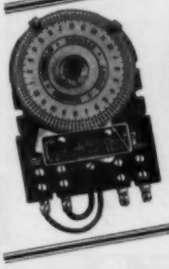
• This No. 191F Patrician Model TORK CLOCK has, with its etched and colored dial and chromium finished front plate, the appearance of a piece of custom jewelry. In size it is the smallest TORK CLOCK ever made but it has the same powerful, completely enclosed self-starting synchronous motor as is in the new No. 191A and the No. 962A. Its single pole switch has a rating of 15 amperes. For use where appearance really counts. By the addition of a chromium finished border plate, listing for $1.00, it can be mounted flush with the wall.

$14.00



• The No. 191A is the most popular TORK ever brought out. There is nothing to loosen or tighten to set it and the 15 ampere single pole switch is both simple and strong. The rotor, field coil, and all fast moving parts are completely sealed and built for service. It is housed in a sturdy pressed steel box with plenty of wiring room and a completely removable cover.

$12.75



• The new No. 962A TORK CLOCK is a completely revitalized Little Giant having the easy to set dial of the No. 191A and also the same powerful motor. Its double pole 20 ampere switch has many improvements, not the least of which is the method of handling the motor leads and the solderless lug load and line connectors. It is housed in the same pressed steel case as the No. 191A.

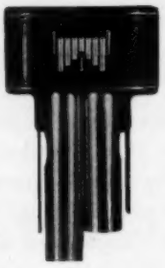
$15.00

The Tork Clock Company manufactures time switches and timers exclusively. *You and your customer* benefit from this concentration.

THE TORK CLOCK CO., Inc.
MOUNT VERNON NEW YORK
Agents in Principal Cities

MELLO CHIME *Leads Again!*

A COMPLETE new line of fifteen models including a wide choice of smart styles and color combinations to harmonize and grace any interior priced from $1.00 upwards—



Through our many years of pioneering experience, Mello Chime offers the most sensational engineering improvement in chime history. Now, for the first time our entire line excepting the motor-driven, four tube type, will operate on present doorbell wiring or any standard 8 volt transformer through 200 feet of secondary wire removing the most serious resistance to consumer sales.

The superior quality of Mello-Chimes is universally known and through our national advertising your customers are specifying "Genuine Mello-Chimes."

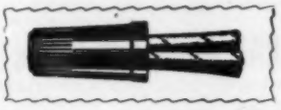
• Ask about our new "Builder's Special". Be prepared to demonstrate the Mello-Chime line of quality chimes. See your Mello-Chime distributor or write for new illustrated brochure.

MELLO CHIME & SIGNAL CO., INC.
220 WEST 42ND STREET NEW YORK, N. Y.

A perfect joint in 20 seconds!

with

The MARR
A Perfect Joint Connector
(CAP MADE OF BAKELITE)



Write for Free Samples

Made for standard wire sizes and for various combinations of wire sizes. Quick, simple, modern. Connector caps made of insulating BAKELITE. A screw driver and a twist of the fingers and the connection is made. Send for samples (FREE) and prove the savings you'll make on your next wiring job.

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When you give an order for appliances, make sure that the cords will be satisfactory. Make it definite that the bracelet label of Underwriters' Laboratories is to appear on every cord. The label gives assurance of proper safety, and your customers will be looking for it.

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AIR RECIRCULATOR AND COOLER

Combined With Indirect Lighting

These attractive and effective air recirculators take the cool air from the floor and distribute it in all directions, quietly, and without annoying drafts. New . . . Basically DIFFERENT, Kisco "DEFLECTOS" are offered in several sizes and models.

Direct and Belt Drive Exhausters

The Kisco line is complete . . . Sold on performance and air delivery . . . Not size in inches. Here is the PROFIT LINE FOR '39. Cash in on it!

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MODERN ARCHITECTS and BUILDERS ARE YOUR BEST CUSTOMERS

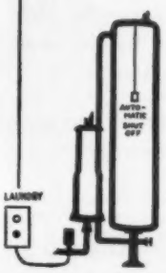
They know a factor that helps sell homes is the

SAVUTIME

WATER HEATER CONTROL

● Time has become a mighty important factor in the modern home . . . and it's those devices which make for greatest time and step saving which have greatest appeal to the housewife.

SAVUTIME lights the heater instantly at the touch of a button in bathroom, kitchen or basement. It is turned off automatically should the user forget. Saves 30% to 50% in gas bills. Installation is extremely simple, and means extra profit for the contractor.



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SAVUTIME DEVICES, Inc.

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NON SLIP ★

MARTIN

VISE STAND AND PIPE BENDER

★ *it's portable*
★ *sets up in ½ minute*
★ *saves time on cutting and threading conduit*
★ *stands without hitching*

A genuine time saver — threads or cuts conduit up to 2½"—bending capacity ¾"—carry it right to the job —folds compactly in 30 seconds. Let us send you more details or see your wholesaler. Also made in a large size for handling conduit up to 4½".

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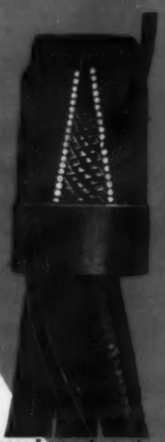
OWENSBORO, KENTUCKY

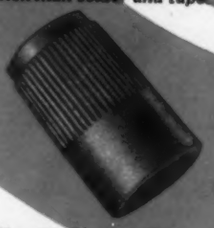
"The Accepted Standard" In The Electrical Industry

IDEAL Wire-Nuts

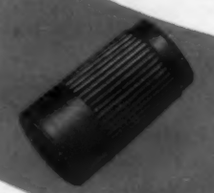
For Better Wire Connections



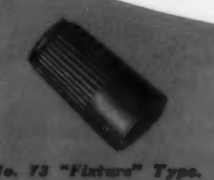
Tapered spring insert presses clean threads into wires—acts as a current carrying sleeve. Gives better electrical and mechanical connection than solder and tape.



No. 76 "Large Universal" Type.



No. 74 "Standard Universal" Type.



No. 73 "Fixture" Type.

No. 72 "Fixture Appliance" Type.

The use of *Ideal* "Wire-Nuts" is *standard practice* with thousands of electrical contractors and architects. They specify *Ideal* Wire Connectors because they are the "Modern Way" to make better wire connections.

Joints made with *Ideal* "Wire-Nuts" cost less than solder and tape joints.

Stronger Mechanically— Better Electrically

Easy to carry, easy to use. Today, bulky wiring outfits—solder, tape and blow-torch—are obsolete—a pocketful of *Ideal* "Wire-Nuts" is all the electrician needs.

NO Solder, Friction Tape, Rubber Tape, Flux, Twisting Wires, Blow Torch, Fire Hazards

NO Soldering Iron, Solder Cups, Smoked Ceilings, Burned Woodwork, Loose Connections, Shorts

Easy Application —Strip wires, twist the "Wire-Nut" on and it's done! As easy as turning a nut on a bolt. No tools necessary.

Better Joints —*Ideal* "Wire-Nuts" provide wire connections almost three times as strong as the best soldered connection. Increased electrical conductivity, too!

Safety —Joint Insulation will not fail. Molded bakelite "Wire-Nut" protects workman from shock. No danger of exposed joint wires—solid bakelite in place of frayed friction tape!

Quick Approval by Inspector —More uniform joints, stronger, easier to test.

Fully Approved —Listed by Underwriters' Laboratories, Inc.

Millions in Use!

IDEAL COMMUTATOR DRESSER COMPANY
1041 Park Avenue Sycamore, Illinois

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SHATTER-PROOF HIGH SPEED STEEL HACKSAW BLADES
ASK FOR
MILFORD *Flexible* REZISTORS

At last—fewer blades per job, more jobs per blade—with the MILFORD FLEXIBLE REZISTOR, that cuts through metals at a speed which burns out ordinary blades, that gives 8 to 10 times more service regularly, that stands up under the hardest kind of use—even abuse. Made of special high speed alloys, this sensational new blade, with hard teeth but soft back, assures truly phenomenal economy. And, though you saw faster than ever before, you won't—you can't—shatter a MILFORD FLEXIBLE REZISTOR — the safety blade with those ever-useful Easy-Starting Teeth.

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CHAPEL & MILL STREETS
NEW HAVEN, CONN.

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SET SCREW CONNECTORS

A COMPLETE LINE

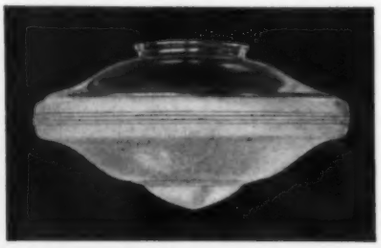
★ Made in 14 sizes for stranded or solid wire. Dimensions and proportions held to accurate size. Made of solid brass by the well-known Sherman Precision Method.

Each size plainly marked for easy stock keeping and reordering.

Send for Bulletin No. 8

H. B. SHERMAN MFG. CO.
Battle Creek, Mich.

If you would be sure . . .



12180 L. S. B.*

to protect the eyes of the young and the sick, specify that the globes used for lighting schools and hospitals be made of the new L. S. B. Low Surface Brightness glass. This beautiful dense white glass illuminates with a caressing softness that cannot fail to benefit. The surface brightness does not exceed 1.3 candle power per square inch, while globe efficiency of 77% assures light in ample quantity.

To get the protection of a globe of L. S. B. quality and performance, specify, "A blown globe of single layer glass thruout, the lower portion of which shall be dense white (without enameling or applied color); the upper portion almost clear glass with sufficient translucence to afford a measure of diffusion. Globe brightness shall not exceed 2 candle power per square inch at any point below the horizontal; over 80% of the light shall be reflected upward, with globe efficiency not less than 75%."

Write for folders describing this glass in more detail and ask for a fragment of L. S. B. glass, cut from a globe.

GLEASON-TIEBOUT GLASS COMPANY
99 Commercial Street — Brooklyn, New York

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Apartment Buildings
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A FIXTURE FOR EVERY OUTDOOR PURPOSE

Send for our
CATALOGUE NO. 40
with NEW SUPPLEMENT
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200 Illustrations

The
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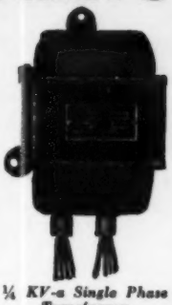
SORGEL
AIR-COOLED
Transformers

a size and type
FOR EVERY PURPOSE
standard stock sizes
¼ to 50 KV-a
Larger sizes to order



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IDEAL and ECONOMICAL for
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Write for descriptive bulletin and prices.

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BUYING HELP WANTED

No need for this sign
when you have an
ELECTRICAL BUYERS REFERENCE

Containing complete information on electrical and allied products

Use your copy regularly to save time and money!

ELECTRICAL CONTRACTING
330 West 42nd Street, New York

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RITTENHOUSE
CHIMES
Choice Of Home Building Experts

- **Beautiful Tone... Smart Styles**
- **Nationally Advertised**
- **Complete Line... Popular Prices**

Rittenhouse Chimes were selected by nationally known home building experts for *exclusive installation* in House Beautiful's Bride's House in New York—in the P.E.D.A.C. "House of Homes" in Rockefeller Center, N. Y.—in "Homewood—the All-Gas-Good Housekeeping House" at the N. Y. World's Fair. Also the "Model Home of America", Board Walk, Atlantic City, N. J.

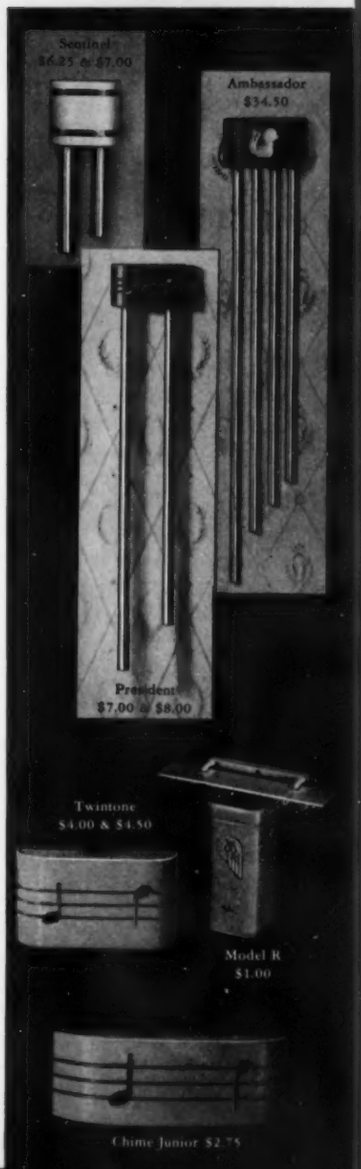
Rittenhouse Chimes have superb tone, smart styling, rugged construction, a wide variety of models and finishes suitable for any type home, apartment, office, etc. List prices range from $1.00 to $50.00 including tubular and bar chime models.

Rittenhouse is the name the public knows. Extensive national advertising in magazines has built up public acceptance. Hundreds of thousands of Rittenhouse Chimes are in daily use. Every Rittenhouse Chime is guaranteed to give satisfaction.

Specify Rittenhouse Chimes when making up specifications. Also specify Rittenhouse Door-Bell and Signalling Transformers for small transformer use.

★*Get the facts. Write for catalog describing complete line of door chimes and transformers Or call your wholesaler today.*

THE A. E. RITTENHOUSE CO., Inc.
Dept. 359 Honeoye Falls, N. Y.



RITTENHOUSE
ELECTRIC DOOR-CHIMES

Earl Whitehorne, Editor

NISA Progress Suggests More Needs

NISA meets this month in St. Louis for the annual convention of the motor shop men. NISA is moving forward—more members, more activity, a broader view—as witnessed by their program. Not the least interesting feature is evidence of more attention to management and selling.

The technique of motor repair is well developed. NISA members know what to do when a sick machine comes in. The big question is where is there more profitable business? How can the motor shop best serve the plant staff of the big factory? How can the earnings be increased? And that side of this business has been neglected too long.

Is Rural Inspection Enough?

REA projects have generally adopted rigorous inspection regulations. In most areas the inspectors are well trained men. Yet, there is little or no control over who installs the wiring. In many instances farmers do their own. A large proportion of the work is going to comparatively inexperienced men who have set themselves up as electrical contractors. Some of these men are quite capable. Some are not.

In one state that requires contractor licensing, a typical examination passed only 14 out of 187 applicants. These men considered themselves electricians but were found incompetent. Yet men of similar caliber, unable to pass a rudimentary examination, are doing farm wiring in states unprotected by licenses.

Rigorous inspection will eliminate the worst mis-fit. But a good many headaches could be avoided by taking some measure of the wireman's ability before he is turned loose to wire farms. Even though most of our cities have high grade inspection facilities, many of them have found it necessary to exercise some control over who shall do the wiring. How much more is it necessary on the farm, where fire protection is not at hand.

Watch the Women's Magazines

Women's magazines have become thoroughly interested in the subject of more adequate wiring. They are running articles about it—pointing out to the readers their need for plenty of outlets and plenty of capacity. Thanks to the work of the National A/W Bureau the subject is now receiving active discussion by those many publications for the home.

The importance of all this to the electrical contractor can hardly be exaggerated. For it is only public interest and demand that will arouse the speculative builder and the architect to action. Then adequate wiring will become standard.

Value in Trade Shows

As spring comes, we see another series of electrical trade shows put on in larger trade centers by manufacturers and distributors of electrical products. To some, these exhibits mean a trip to "the city" to meet friends and competitors in a holiday spirit. Many electrical men stayed home, too busy or not interested in this sort of thing.

But to an important number of contractors and plant electrical men, the electrical trade show provides very practical help. Here are the latest products displayed and explained by factory experts, who show how to sell better jobs, to make better installations.

We like to feel that the exhibitors were well repaid for putting on these valuable shows. But more important is the broader use of the suggestions that come out of them.

Keep Off Thin Ice

In these days of modernization the salvage market produces plenty of headaches. It brings up the old question of what is junk and what is safe, re-usable electrical material. Owners, and some contractors, sometimes lose sight of safety in the interest of an initial saving in cost.

It is one thing to re-install reasonably new safety switches, panelboards or even wire that is taken from a revamped job. But too often, inspectors are being asked to approve installations in which salvage items of questionable fitness are used. It puts the inspector on thin ice.

Some of the larger cities have regular dealers in salvaged electrical materials. Do they know or care how old, or how badly abused their items may be? Since labels are usually missing, the inspector can only draw on his knowledge. But quality-minded contractors can help by giving their support to the inspector who faces this issue with firmness.

Hobby Wiring

What with the more abundant life, the average solid citizen is spending more time in his cellar than he has since prohibition days. He has a hobby.

A gum-shoe survey of suburban basements would uncover miniature railroads, complete machine shops, amateur radio stations, photographic dark rooms and hundreds of similar evidences of good hobbies. Yet 90 per cent of the wiring to aid and abet such goings-on is unsullied by the electrician's thumb print. Haywire is the almost universal rule.

Hobbies in these days take plenty of juice and there is probably no easier lever for parting a man from his folding money. Sell him an extra

appliance circuit for the kitchen and he will be pleased. But sell him a heavy duty plug in the living room, where he can connect a pair of number two photo floods, without blowing the main fuses, and he will love you like a brother.

Decentralization Poses a Problem

The movement of industrial plants out of large population centers and into smaller cities and towns is giving motor shop operators some tough problems. Pick-up, delivery, and emergency service on a reasonable price scale is not so simple when the customer is 50 miles away.

At the same time, there is a greater market for stand-by and emergency replacement motors. Furthermore, the plant located a long distance from service facilities is a natural prospect for a routine instrument check-up that will catch trouble before it happens.

Fluorescent Plums

Estimators must have good light for doing long stretches over blue prints with rotometer and tally meters. So quite a few larger contractors are putting daylight fluorescent troughs overhead. Results have already proven that this cool and efficient light source gives a big lift from the tedious job of finding electrical symbols on mechanical drawings.

Note also that here this lighting has been put to work for the contractor's own benefit, and he is better able to sell the same equipment with confidence to the waiting market. These are plums in this fluorescent pudding and contractors might as well learn how to pull them out—for themselves and for their customers.

Guess Losses Are No Joke

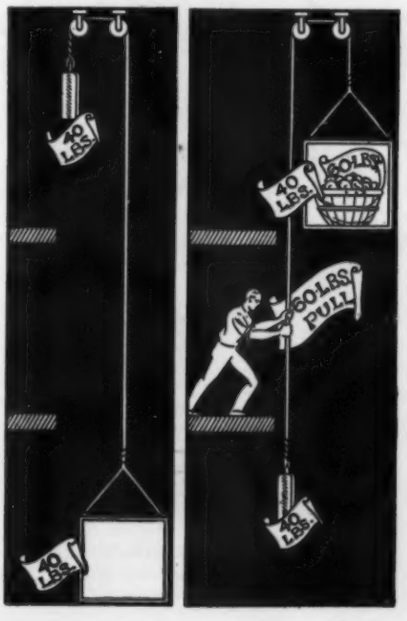
A stock gag in the electrical contracting industry is about the contractor who thumbs frantically through his estimate sheets every time he gets a job, to find what he left out. But, it is not so funny. It is discouraging to see a job to which you have devoted your skill and knowledge, go at a price so far out of reason that you might just as well have taken the time fishing.

But wherever contractors have the good sense to meet together and hold post mortems over estimates, it is found that the out-of-line bidder has made either a serious mistake in take-off, applied faulty short-cut estimating methods or guessed at the labor cost of unfamiliar operations. If the short-cut experts and guessers would figure high, everyone would be happy. But it doesn't work out that way. They invariably guess low. The remedy is a wide distribution of accurate labor units and estimating information throughout the industry, backed by freely publicized labor cost data from actual job experience.

Back Talk

Are We Ashamed!

To the Editor—Unfortunately an error was made in illustrating Ward Harrison's article on Power Factor, in the February issue of *Electrical Contracting*. This illustration should have shown the same rope carrying the 60-lb. load of potatoes and also the weight of the dumb waiter. The balancing 40 lb. iron weight would therefore, be attached to the same rope the man pulls as in our picture. This added constant load of 40 lbs., makes a total strain of 100 lbs. on a single rope. So when the rope is under a strain of 100 lbs. with a useful load of only 60 lbs., Mr. Harrison indicates that this is analogous to an electric circuit having a 60 percent power factor. The 40 and 60-lb. pulls must be added together and the rope must be "larger and stronger than would have been necessary if you had no dumb waiter."



I believe this corrected illustration with a statement exonerating Mr. Harrison will eliminate any further embarrassing criticisms from readers of the magazine.

Walter Sturrock,
General Electric Company,
Nela Park.

We fall back on a story. A colored gentleman was standing on the scaffold and the sheriff said—

"Jim, have you got anything you want to tell us, before you die?"

"Well, Boss," he said, "I ain't got much to say I guess, 'cept this suttinly is going to be a lesson to me!"

Our humble apologies have already gone to Ward Harrison. Of course, we blamed it on the artist. The picture should have been like this one.

But There You Are!

To the Editor—When my copy of your paper for February arrived, I dropped everything to glance through it. I came to the article entitled "Explaining Power Factor." I believe the fluorescent lamp is the most remarkable development in illumination since Tom Edison, and the men responsible deserve more than the wet blanket thrown on them by Mr. Harrison. The bogey man "Power Factor" should not be allowed to enter the picture at this time.

Power Factor is the foam on a glass of beer. You pay for it but it doesn't do a bit of good. Just think what will happen when men find out that their beer might be 40 percent foam? Why the consequences are positively alarming.

Please do not smear the pages of such a fine publication as *"Electrical Contracting"* with stuff so detrimental to the efforts of the men who have discovered and developed fluorescent lighting. Instead let's give them our heartfelt thanks and encourage them to go on.

John F. Mahoney,
Medford, Mass.

Frankly, Mr. Mahoney, we don't see just why you are upset over Ward Harrison's article. The fluorescent lamp is going to do big things for us, both in industrial and in decorative lighting. But there is no use closing your eyes to the fact that it has a 60 percent power factor and where it is used in any quantity the additional 40 percent must be taken care of. It is just like a dog having fleas. It's too bad but there they are.

The part that bothers us is that you seem to feel that low power factor detracts from the value of fluorescent lamps and is going to hurt their sale. We don't believe it will. It is also unfortunate that the fluorescent lamp requires an auxiliary ballast, but it does and there you are again. And by the way, Ward Harrison himself helped develop this new lamp.

"What Comes of It?"

To the Editor—The editorial "Why be Afraid" is very good in what it says but what becomes of it; absolutely nothing. I have often pointed out hazardous wiring which should be corrected, but the answer is invariably, "It has been working that way without any breakdown so why change it."

We contractors have to compete with the rankest kind of amateur work from school boys and furnace men. When we solicit business, we are told that the janitor or some other employee is quite handy and does the necessary repairs. We are hoping to correct this by licensing in Pennsylvania, if it ever goes through.

Louis Stern,
Philadelphia.

The whole purpose of the editorial was to point out that something can be done about it. Something can be done about it in your town. At the present moment there may be opposition to any organized effort to arouse people on the subject of danger spots in their wiring. But it is sufficiently important to be taken up by the contractors association and the electrical association in every city, to the end that re-inspection may be speeded.

WIRING Methods

PUTTING STARTERS ON THE SPOT

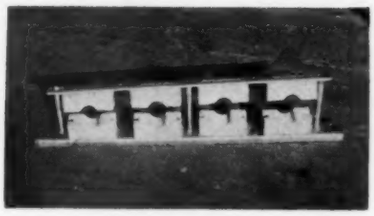
Fine structures usually require equally neat workmanship in the mechanical rooms. In the Edison Institute of Technology in Dearborn, Mich., the tiled walls and floors made careful spotting of stub-ups necessary. Here the McCleary-Harmon Company of Detroit had to set starters beside motor drives without marring neat tile floors. It was done by bolting channel iron supporting members to the bases of pumps and compressors. Thus the only openings in the tile are those needed for stubbed-up conduits.

TILE SAVER—Starters mounted on iron supports, which bolt to machine bases, saved marring tile floor.

FOUR-CLEAT CABLE RACK

Distribution cables supplying various exhibit buildings of the Golden Gate International Exposition at San Francisco required supports which would provide maximum safety at reasonable cost. These cables ranged in size from 1/0 to 4/0, and were run open on the trusses under the floors of various structures.

Special racks were designed to hold four two-piece porcelain cleats required for 4-wire feeders. The lower halves of the cleats were fastened to a light steel channel base. This channel was made with ends extended for bolting it securely to trusses. Three through-bolts in the base member were made long enough to extend through holes in a flat-iron strap to which the upper halves of the porcelain cleats were secured. Cables are placed in the grooved cleats and made secure by tightening nuts on the through-bolts.



EASY TAKEUP—Assembly of split cleats on steel straps for 4-wire feeders at San Francisco Exposition.

SUSPENDED LIGHTING EASILY RESPACED

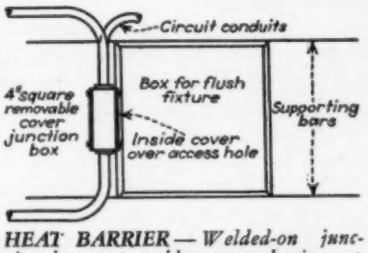
For ease in random spotting and subsequent respacing, steel messenger cables were used for suspension of mercury vapor lighting units and ballasts in one of the new buildings in the Riverdale plant of Acme Steel Company, Chicago, Illinois.

The messenger is a standard $\frac{3}{8}$ inch, seven-strand galvanized steel cable, held in tension at the end walls of the building and resting on the bottom chords of the roof trusses. The $\frac{1}{2}$-in. conduit drops for 400 watt high pressure mercury lamps were hung at required distances along the messenger. About a foot along on the cable from the lighting unit is hung the ballast transformer for the lamp. Pairs of rubber covered wires were run parallel to the messenger and about a foot away. The conductor pair is carried in a single lead under tension, with porcelain split sleeve supports on the truss chords and with strain insulators in the lead for isolating circuits. Since the horizontal circuit conductors are run open, the lighting units may readily be changed to closer or longer spacing, and easily energized, as lighting requirements may dictate.

MESSENGER SUSPENSION — makes H.I.M.V. lighting installation easy to space and re-arrange.

WIRING TO AVOID FIXTURE HEAT

In terminating rubber covered circuit conductors at built-in. lighting fixtures, there is danger of injury to the insulation because of radiated lamp heat. H. H. Mandly of Hartford avoided this trouble during the installation of 3,000 flush fixtures in a local department store



HEAT BARRIER — Welded-on junction box stops rubber covered wire outside the heat zone of built-in fixtures.

and also simplified wiring and conduit connections.

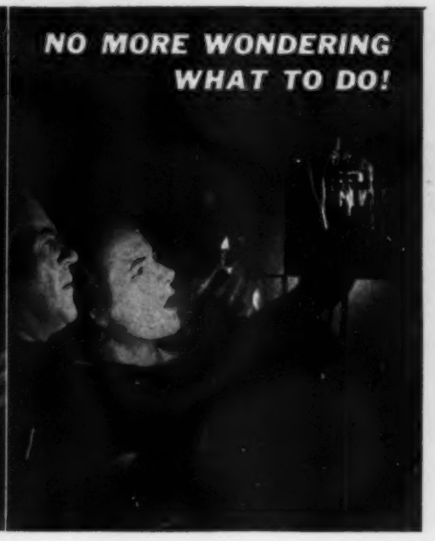
The steel cabinets were provided with welded-on 4 in. square outlet boxes covering access openings on the ends or sidewalls. Rubber covered circuit wires were spliced in these junction boxes, outside the fixture cabinet, to fixture tap conductors having heat resistant insulation. The tap wires were taken to the fixture sockets through holes drilled in asbestos covers which were placed over the access openings inside the fixture cabinet. Thus the rubber insulation was isolated from fixture heat.

The built-in fixtures ranged from one-gang to 3-gang units for general, "accent" and night lighting.

LIGHTS OUT?

NO MORE HUNTING FUSES!

The March to the Cellar is Ended



—*thanks to the Low Cost*

CUTLER-HAMMER MULTI-BREAKER

The Cutler-Hammer Multi-Breaker ends for all time the nuisance of blown fuses. This newest electrical marvel is merely a trim, strikingly modern panel (as shown at the right) which is located on any convenient hall or kitchen wall. When an overload or short circuit occurs anywhere in the house, one of the little levers on this panel snaps into the "OFF" position. And you simply reset this lever to restore service. Could anything be more simple? Nothing to hunt. Nothing to replace. No live parts exposed. And the first cost is the only cost.

One might easily think that anything so modern and so useful *must* be expensive. Banish the thought! A Cutler-Hammer Multi-Breaker adds less than $5.00 to the entire cost of any average new home. And in old homes, even when some rewiring must be done, its cost is surprisingly low. Ask your architect, contractor or electric company for an estimate. Put an end to the fuse nuisance *now*. CUTLER-HAMMER, Inc., *Pioneer Electrical Manufacturers*, 1306 St. Paul Avenue, Milwaukee, Wisconsin.

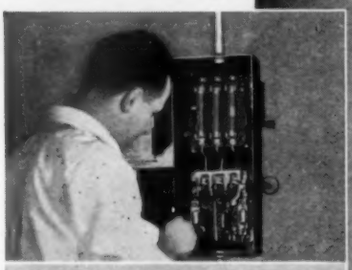
Millions of people . . . your customers . . . are seeing these C-H Multi-Breaker ads

Here's YOUR Advertising

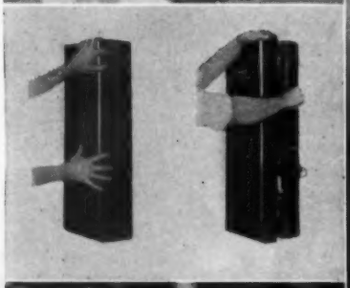
You Profit Three Ways

with the Complete CR7008 Motor Control

1. SAVE ON INSTALLATION — Having all the control required for a motor in a single case, wired ready to install, the installation crew simply mounts the CR7008 and connects the motor, push button, and power supply.



2. INCREASED SAFETY — Operators are protected from contact with live parts in the CR7008 because (1) the cover cannot be opened unless the manual switch is OPEN and power removed; (2) the manual switch cannot be closed to apply power as long as the cover remains open.



3. ATTRACTIVE APPEARANCE — The CR7008 enables you to have better looking installations. This single attractive case, replacing two or more separate controls with interconnecting wiring, makes possible wiring jobs that are neater in appearance.

CR7008 combination switch with manual disconnect switch, fuses, and magnetic motor starter

IF you've never used CR7008 combination switches, your first trial will make you wonder why you haven't. They embody the same high-quality mechanism that is employed in the popular CR7006 magnetic switch—including isothermic overload relays. But, in addition, they include a manual disconnect switch, and fuses (or manual circuit breaker if desired). You'll need these for a motor, anyway. This CR7008 provides them all in an attractive, ready-to-install combination.

General Electric Company, Dept. 6A-201
Schenectady, N. Y.

Please send me your new folder describing the CR7008 Combination switch. (GES-1618)

Name.....

Address.....

City..... *State*..... 080-188

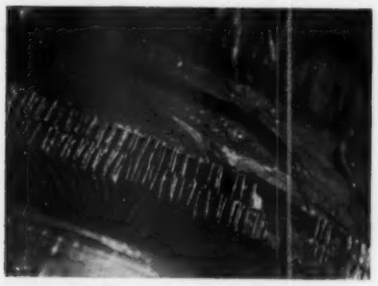
GENERAL ELECTRIC

Motor Shops

A COAL MINE BREAKDOWN

One of the tough jobs brought into the Penn Electrical Engineering Company's shop in Scranton, Pa., was an armature from a 300-kw. rotary converter. This is a six-phase a.c. to 275 volt d.c. machine used in one of the coal mines. Loose connections had apparently developed, where the armature windings were connected to the risers of the 432-bar commutator. The resultant arcing is thought to have set fire to carbon dust in the hollow spaces inside the commutator shell. As a result of this arcing and local fire, the 1½ in. wide sheet copper risers were burned off, and the red rope paper and canvas beneath a span of coils destroyed.

To remedy this breakdown, about half the coils were being unsoldered. Repairs called for new layer insulation of fish paper and varnished cambric and new coil insulation in the burnt area. Some of the arced-off copper risers from the commutator bars were also replaced.



***TROUBLE SPOT** shows effect of arcing and burning carbon dust at 432-bar commutator.*

***CONVERTER BREAKDOWN** — A 300-kw., a.c.-d.c. converter caught fire from loose commutator connections.*

ADJUSTABLE BRACKET FOR SMALL STATORS

Winders of small stators work in comfortable positions at the Jacksonville (Florida) Armature Works. It was done with a 2-in. pipe stanchion and an adjustable bracket or rest for the stator, that permits the winder to place his work at the height best suited to his stature and style of inserting coils.

Small tools, insulation and wedges are accommodated upon a sheet metal tray clamped to the stanchion directly below the stator bracket. Two shaded lights are provided above the work to direct light toward opposite sides of the stator shell.

The assembly of this outfit required pipe, floor and wall flanges, sheet metal for the tray, a pair of connecting rods from an automobile engine and minor fittings.

***WINDER CONVENIENCE** — Small stators rest on adjustable brackets for worker's convenience.*

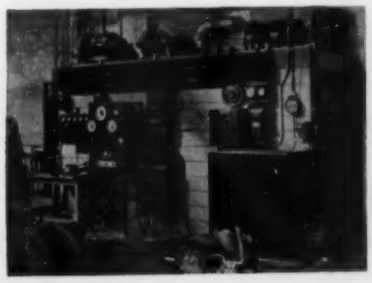
SHOWING HOW TO LIGHT THE STOCKROOM

When customers stop at the supplies counter of the Sterns Electric Equipment Company in Buffalo, N. Y., they see a practical demonstration of modern stockroom aisle lighting in routine use. With plant and building employees coming in throughout the day, this lighting creates attention and leads to inquiries among those who need similar improvement in their own premises. The three 100-watt Goodrich units are installed on 9-ft. centers, suspended from ½-in. conduit stems.

***SILENT SALESMEN** — Supply bins have modern aisle lights that suggest practical needs to drop-in trade.*

CUTTING DOWN SHOP SPACE

By placing testing transformers, motor-generator set and frequency changer atop its oven, and the test panels on the sidewall, the Quality Electric Company, Ltd., of Los Angeles, saved considerable shop space. Since the oven is well insulated the testing apparatus is not subjected to objectionable heat.

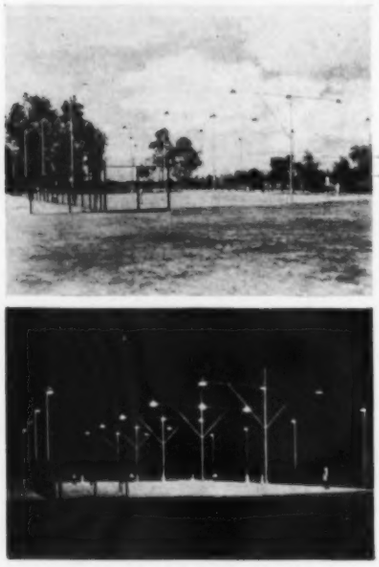


***OVEN BALCONY** — Testing equipment parked on the oven roof and sidewall saves shop space.*

Better Lighting

HIGH LEVEL TENNIS LIGHTING

J. E. Hammond of the San Joaquin Light and Power Company recently designed a lighting installation for a group of tennis courts on the public playgrounds at Fresno, California. It is somewhat out of the ordinary in construction features. The location of the lights is accomplished without the usual forest of poles. Illumination behind the back base lines is provided by lighting units mounted at the ends of each court, tilted 20 degrees from the vertical so that the light is cut off at the net line.



NIGHT TENNIS—New installation in Fresno provides high level illumination with few poles.

Twenty-five footcandles is provided when a single court is in use and 30 footcandles on the inside courts when the four courts are illuminated. Benjamin Play-Area floodlights are employed, equipped with 1500-watt lamps and arranged 8 per court. Separate control of each court is had by using a coin switch and contactor. All wiring is underground. A three-phase four-wire system is used, with cable of the tellurium compound type.

Provision has also been made in the main feeder for lighting the four adjoining courts. The end poles are equipped with an extra support for attaching the end light when the adjacent courts are lighted.

WAYS TO LIGHT GLASS BLOCKS

Glass block installations can be divided into two classes—those in which no background is desired and those having a background. General lighting for either type can be provided by concealing polished concentrating reflectors at the top, bottom or sides of the block design, directing the beams onto the blocks. Color patterns can be produced, either by alternating colors in the reflectors or providing varying colors upon the different sides. Individual reflectors may be used or a parabolic cylindrical trough reflector, which throws a fan-shaped beam of light.

Another method for both open and closed panels is to place reflectors in back of the blocks so as to project the light directly to the blocks. When the bulk of the blocks is exposed the reflectors conceal the view of the lamps and appear as silhouette spots. If large reflectors are used, they should be placed back from the blocks a considerable distance, depending upon the space to be covered. But in general the units should be spaced no farther apart than the distance of the lamp filament from the glass. Small reflectors, such as the Climax type, can be arranged so that one or two are used for each block. They can also be used for color accents with light tinted general lighting from the edges or from behind the blocks.

In places where backgrounds have not been provided, draped materials have often been used, thereby producing much the same effect as provided by a background. Venetian blinds have also been hung behind blocks to provide backgrounds.

Blocks can be lighted individually in a variety of ways. In general, clear lamps with color hoods are preferable to sprayed lamps due to their greater color efficiency. They may be used, one per block, in the center or at a corner. Two per block, in contrasting colors, lend interest to the display.

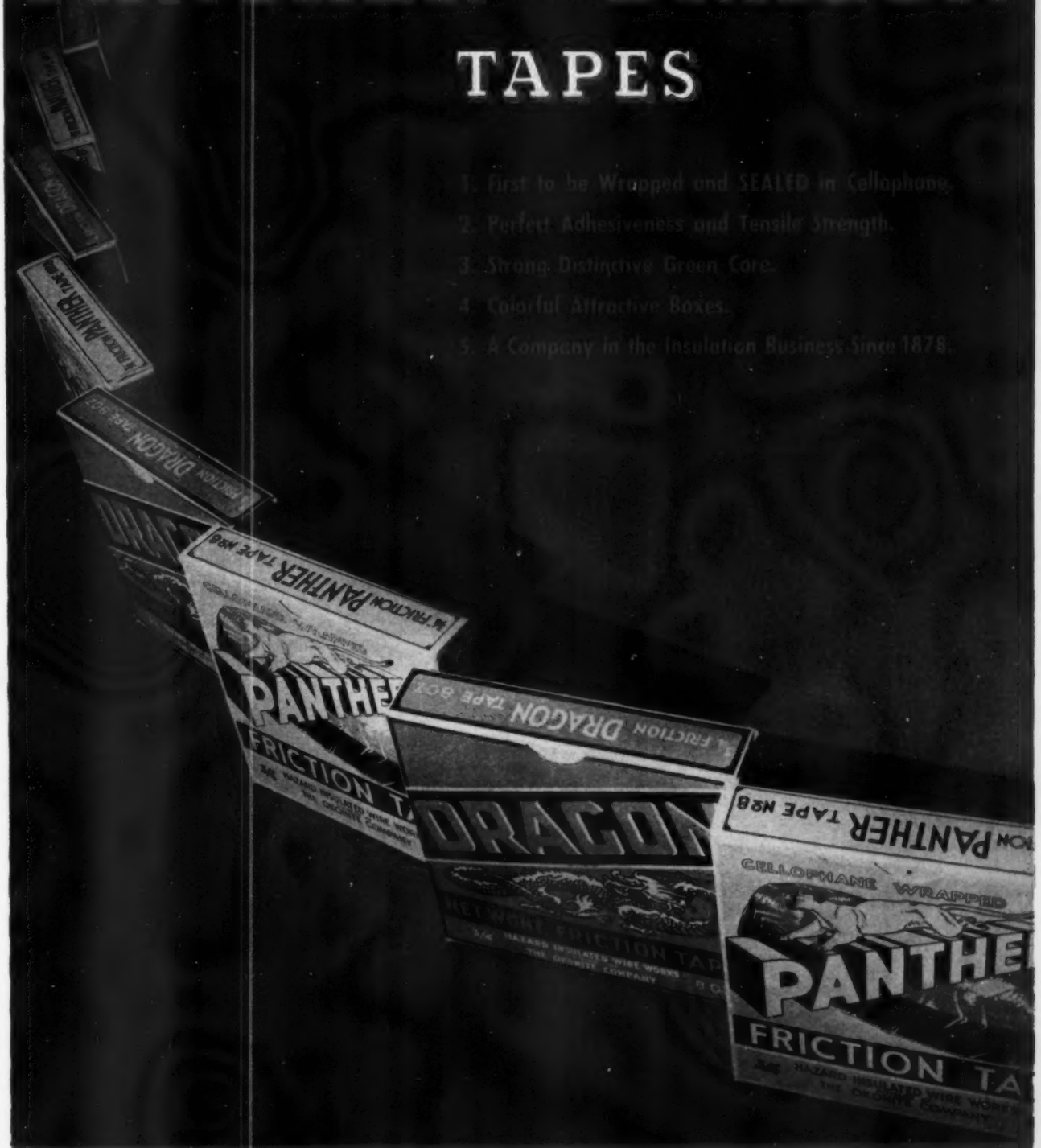
Other combinations are made by using lumiline lamps with accents of A-bulb lamps or reflectors. By placing a row of lumiline lamps along one edge of a row of blocks, then adding a single concentrated source at one of the opposite corners, an attractive lighting result may be obtained. Lumiline lamps along two edges at right angles to each other and accented by single concentrated sources, provide a more elaborate effect. For example, yellow might be used at one edge and surprise pink at the other, with natural colored green for the accents.

In planning the lighting for large ceiling or wall surfaces, a combination of these various methods can be used to obtain almost any desired pattern.

WEEK-END CHANGEOVER—When office workers returned on Monday morning to the Crowe Nameplate Co., Chicago, they beheld this new installation of 125 indirect units. W. G. Cookley was the contractor who installed these 300-watt Guth York Illuminants. Hung at the extra length of 42 inches at 11-ft. centers, an even illumination of 20 to 23 f.c. is provided.

PANTHER and DRAGON
TAPES

1. First to be Wrapped and SEALED in Cellophane.
2. Perfect Adhesiveness and Tensile Strength.
3. Strong Distinctive Green Core.
4. Colorful Attractive Boxes.
5. A Company in the Insulation Business Since 1878.



HAZARD INSULATED WIRE WORKS

DIVISION OF THE OKONITE CO.

WORKS: WILKES-BARRE, PENNSYLVANIA

New York Chicago Philadelphia Atlanta Pittsburgh Buffalo Boston Detroit
Seattle Dallas Washington San Francisco St. Louis Los Angeles

Estimating

CLOCK INSTALLATION COSTS

An accurate check on the installation of a clock, buzzer and plug board system in a Battle Creek auditorium building gave the following labor data. The figures shown are net mechanic and helper time and do not include any allowance for non-productive or supervisory time.

1. *Master clock*—mounted on the wall and connected.

Total time—9 m.h.

2. *Plug board*—setting and connecting complete:

Total time—8 m.h.

3. *Clock relay cabinet*—Setting and connecting complete:

Total time—2 m.h.

4. *Corridor clocks*—installed on special brackets, which were either fastened to the columns or imbedded in the walls to hold the clocks in place. There were a total of 6 clocks:

Total time—19 m.h.
Average-each—3.17 m.h.

5. *Room clocks*—Hung on a bracket extending across the face of a special clock box. Three wires extending from box are connected to each clock. There were a total of 32 clocks:

Total time—9 m.h.
Average-each—.42 m.h.

6. *Room buzzers*—Using a portable telephone set on clock wires to talk over, each buzzer was connected to a common and one individual conductor. There were a total of 29 buzzers.

Total time—4½ hours
Average-each—.15 m.h.

The above time studies do not include roughing in conduits and boxes or pulling in wires. (*From A. F. Gould, Central Electric Co., Battle Creek, Mich.*)

ADVANCE WORK SAVES EXPENSIVE DRILLING

The efficiently handled job entails a minimum amount of drilling through floors for riser conduits after concrete is poured. Sleeves must be placed for such risers. Moreover, the installation of anchors for conduit hangers and racks can be avoided by installing concrete inserts before various slabs are poured. The savings in estimated labor resulting from such advance work can be anticipated, provided the job is properly engineered to follow through on the careful placing of devices before slabs are poured.

Take a small concrete building as an example. The estimated cost to spot and place inserts and sleeves in slabs and walls before pouring is given. For concrete inserts the average cost is from 12 to 16 hours per 100. For sleeves the cost runs 18 to 24 hours per 100. This job required—

28 inserts for ½-in. hanger rods for conduit racks at .16	= 4.24
14 sleeves for riser conduits at ..... .24	= 3.36
Total labor cost.....	7.60 hrs.

To drill these holes later by hand would have cost—

28 holes in concrete for ½-in shields at..... .43	= 12.04
14 holes through concrete floor	
4—for 3-in. conduit—12 in. wall at..... 4.00	= 16.00
6—for 2-in. conduit—8 in. slab at..... 3.00	= 18.00
4—for 1½-in. conduit—8 in. slab at..... 2.50	= 10.00
	56.04 hrs.

From these figures it is evident that the concrete inserts, installed to provide for a run of racked feeder conduit, saved the difference in labor between 4.24 and 12.04 hours. Setting sleeves for riser and wall-piercing conduit runs amounted to 3.36 hours, whereas to drill these holes would require 44 hours. The foregoing comparisons indicate how and why it pays to plan jobs in advance, and particularly while preparing the estimate.

HAS BUFFALO HOUSING—Starting off with a $155,000 electrical contract for Buffalo's Lakeview Housing Project, the Ferguson Electric Construction Co. recently secured a second contract covering the Willert Park project for negro housing. Whitworth Ferguson, long active in the local contracting business organized his own company three years ago to handle large industrial and public construction work.

DETAILED BREAKDOWNS OF LARGE SWITCH BANKS

Wiring layouts frequently include the assembly of several sizes of externally operated switches, such as for metering banks in apartments, or combinations of service switches and miscellaneous subfeeder switches in store buildings. Some estimators make an approximate lump sum allowance for labor to mount and connect these assemblies, based on somewhat similar work done before. But since the layouts vary widely as to combinations of equipment and sizes of wire involved, the most accurate way to estimate such labor necessitates a unit analysis of all work involved.

The usual steps in preparing such an estimate require—

1. A reasonably accurate layout showing the arrangement of equipment and sizes of switches, wireways and conductors from which to list the material and labor units.
2. Unit allowances for mounting and connecting all switches, meter pans and metering cabinets.
3. Labor for interconnecting nipples.
4. Labor for gutters or wireways and fittings.
5. Labor for taps and splices in gutters.

It should be noted that labor for terminating the service conduit, grounding conduit and all load side conduits

leading to outlying points are not figured in with this estimate, but are a part of the estimate covering conduit work. Sometimes these assemblies include the wire for inter-connections, but usually this wire is recapped with the main listings of wire.

An example of estimate covering a typical switch group follows:

	Labor Unit	Extension Hrs.
1 — 600 amp. 3 p. main switch-lighting.	11.6	11.60
1 — 400 amp. 3 p. main switch power..	7.4	7.40
2 — 200 amp. 3 p. branch switches.....	5.3	10.60
8 — 100 amp. 3 p. " "	3.6	28.80
4 — 60 amp. 3 p. " "	2.2	8.80
4 — 30 amp. 3 p. " "	1.7	6.80
2 — 3½-in. factory nipples.....	.7	1.40
2 — 3-in. job nipples.....	1.3	2.60
2 — 30x42x8 transf. boxes.....	1.8	3.60
6 — meter fittings.....	1.3	7.80
16 ft. wiring gutter.....	.8	12.80
2 gutter elbows.....	1.17	2.34
2 — 2-in. nipples.....	1.20	2.40
8 — 1½-in. nipples.....	1.0	8.00
8 — 1-in. nipples.....	.5	4.00
6 — 600/200 amp. feeder taps, solderless.	1.6	9.60
12 — 400/200 amp. " " "	1.2	14.40
24 — 200/50 amp. " " "	.6	14.40
Total Hours.....		157.34

WHAT MAKES A LABOR ESTIMATE

It takes about fourteen to twenty different groups of units to make a complete estimate of the labor required in an average size commercial installation consisting of lighting, power, signals and lighting equipment. A general listing of units most commonly used, runs in this order—

1. Branch circuit conduit or tubing, ½ to 1-in. sizes
   a. Concealed in concrete floor slab
   b. Concealed, steel or concrete joints
   c. Exposed, fireproof construction
   d. Concealed or exposed, non-fireproof construction
   e. Concealed, joist notching included
2. Ceiling outlets—locating and supporting outlet, making entrances with circuit runs. Separate labor costs for seven or more types of ceiling conditions.
3. Wall outlets for brackets, receptacles and switches under various construction conditions.
4. Pulling branch circuit wire
5. Installing wiring devices
6. Feeder and motor circuit raceways, conduit or tubing
   a. Conduit runs
   b. Elbows
   c. Terminals in switches, panels, junction boxes
   d. Bends or offsets
   e. Riser supports
   f. Other supports and straps
   g. Miscellaneous fittings
7. Installing large wire
8. Feeder taps
9. Riser supports and junction boxes
10. Switches and control equipment
11. Panels and switchboards
12. Lighting fixtures
13. Signalling equipment
14. Motor handling and connections

In addition some jobs will entail additional classes of material requiring labor estimates to cover, such as:

a. Wiring channel and fittings for window reflectors or interior coves
b. Underfloor raceway systems
c. Handling, mounting and connecting special apparatus
d. Underplaster extensions
e. Multi-outlet assemblies

After all, a complete estimate is but an assembly of many smaller divisions. The care with which each part is listed for applying labor costs will determine the accuracy of the whole estimate.

For Heavy Construction and Tunnel Work

Protector "O" Heavy Duty Guard

Here is an exceptionally rugged new lamp guard especially desiged for use around heavy construction work. Ideal for temporary installations, the McGILL Protector "O" Heavy Duty Guard is used on scaffolding and framework because it is easily removed and taken to the next job.

The cage of this new guard is made of heavy No. 10 wire with tinned finish, and is reinforced with a ring midway between the collar and the open end to prevent breaking or crushing. The collar is normally open to slip over the weatherproof sockets which are generally used on outdoor work — all you have to do is tighten the screw.

The Protector "O" Heavy Duty Guard is available in two sizes: The No. 14332 for 60 watt lamp; the No. 14333 for 100 watt lamp.

Write for full particulars.

McGILL MANUFACTURING COMPANY
Box 670
VALPARAISO, INDIANA

SUPER-SUPERIOR Insulating Tubing

furnished in continuous lengths

SURCO
SOFLEX FLEXIBLE INSULATING TUBING
meets all these standards:

Patented Process of Specially Constructed Vinyl
It has remarkable physical, electrical and chemical properties.
It is perfectly smooth, uniform, and homogeneous.
Extra flexibility. Can be actually tied in knots, without causing mechanical injury.
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Non-inflammable. Does not support combustion.
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Unaffected by organic acids, dilute acids or alkalies. It is completely insoluble in gasolene, oil, alcohols, ethers, esters, ketones and aromatic hydrocarbons.
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Use it for insulating motor leads
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it has very thin wall diameter, small O.D.
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Questions ON THE Code

Low Voltage Wiring

Q. *I was recently called upon to install a set of chimes operating on 24 volts. I had never done any low voltage wiring. I asked several experienced electricians and they seemed evenly divided on using annunciator wire fastened directly to the surface or non-metallic cable.*

I finally used No. 14 r.c. wire, fastened to the surface with insulated staples and straps. I taped the four wires in a bundle and fished through the wall to the chimes. The house was already wired with annunciator wire for a bell. I used this old wire already installed in the walls and ceiling as part of the new system.—G. K. B.

A. If the transformer supplying the current to the chimes, is approved by Underwriters' Laboratories as a bell ringing transformer, the annunciator wiring would be all right.

But, many of the chimes at present will not operate on bell ringing transformers, but require a transformer of higher power and voltage which is listed as a power transformer. Wiring connected to a power transformer must be run in compliance with the rules of Chapter 3 of the Code, with the exceptions noted in Rule 8006. This would not permit the use of annunciator wiring.

Three Phase Breakers

Q. *Under rule 2351a would it be permissible to use three single pole circuit breakers, one for each phase on a 3 phase 4 wire service? These are to be 600 amperes each and both light and power are to be used from them.*—C. M.

A. No. This arrangement would not be permissible according to rule 2353 where multi-wire (multi-phase) power is to be used. The above arrangement would be all right for lighting circuits and for single phase power only but would not be permissible for the three phase power circuits.

This is made clear by the requirements of rule 2353 which says that the service disconnecting means shall *simultaneously* disconnect all ungrounded conductors except for 3 wire d.c. or single phase (light and power) circuits or multi-wire *lighting* circuits. This last does *not* include multi-phase (2 or 3 phase) power circuits.

Motor Branch Circuit Fuse Size

Q. *"When using Table No. 10 of the Code, do I use column No. 7 when figuring branch circuit fuses for the regular single phase induction-repulsion motors and capacitor motors and for 3 phase induction motors—for example, a hand starting compensator such as G.E. CR1034-K1? Consider this actual installation—a 50 hp., 3 phase, squirrel cage induction motor, 220 volt, using a hand starting compensator CR1034-K1-General Elec. I have a 400 amp. entrance switch, with 400 ampere fuses. Feeders are about 10 feet long from this switch to a branch circuit fuse block, fused 300 amp. The 300 amp. fuses are the branch circuit fuses to the 50-hp. motor. No. 3/0 conductors lead to the compensator and then to motor. These 3/0 conductors are about 25 feet long. Now, if circuit protection should be 125 × 300% = 375 amps. how can the 300 amp. fuses hold while starting? I do no know which tap is being used in the compensator."*—A.C.B.

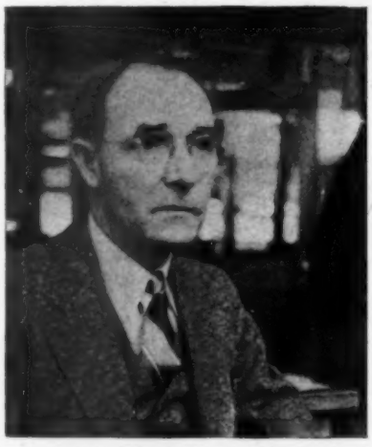
A. In using Table 10 of Chapter 9, column 7 is used for determining the size of the branch circuit fuses of single phase and squirrel-cage and synchronous motors with full voltage, reactor and resistor starting. For squirrel-cage motors using auto-transformer (compensator) starting, as mentioned in the above question, the size of the branch circuit fuse is found in column 8.

Considering the 50 hp., 3 phase, 220 volt motor mentioned, the starting current of which (from Table 14) is 125 amperes, the branch circuit conductors would be No. 000 and the branch circuit fuse would be not over 250 amperes, for compensator starting. The motor running fuses, if cut out during the starting period, (unless of the time lag type) should be not over 175 amperes. If the compensator is equipped with a thermal overcurrent device it should be rated at not over 156.5 amp.

It will be seen from the above that the 300 amp. branch circuit fuses, mentioned in the question, should be reduced to not over 250 amp. And it must be remembered that the purpose of the compensator is to hold down the starting current of the motor by reducing the starting voltage.

But now a word as to the compensator CR1034-K1. A check of Underwriters' Laboratories' listing (pp. 89 and 90) shows that auto-transformer starter, type CR-1034, is listed only for 30 hp. or less. Therefore, an inspector would be justified in not approving such a device for a motor larger than 30 hp.

According to the manufacturer type CR1034-K1—size 2 is built for up to 75 hp., 3 phase, 220 volt. But this is plainly not listed by Underwriters' Laboratories. But the Laboratories have inserted a note under their caption, "Industrial Control Equipment" on page 82 of their List of Inspected Electrical Appliances, reading as follows, (the italics are ours)—



***HE COVERS 'EM**—Populous New York State requires a lot of travelling to keep in touch with electrical inspection problems in its larger communities. But W. L. Bliven of Syracuse, chief electrical inspector of the New York Fire Insurance Rating organization, makes frequent trips to larger cities in 52 counties of the state.*

There are 45 inspectors handling inspections from 19 district offices, and they like to have the chief sit in with local contractor groups when knotty Code problems are in the order of business. Mr. Bliven is active in state licensing and inspection matters, and is also a member of the Electrical Council representing IAEI.

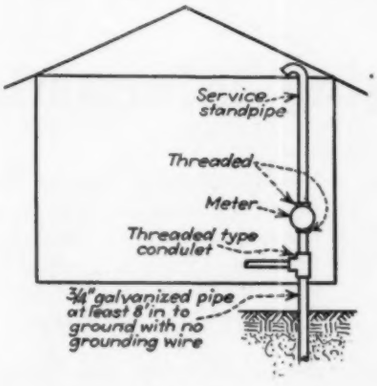
"The following listings include Industrial Control Equipment rated at 100 A or less, 30 hp. or less, 600 V or less. *Some* of the following manufacturers are prepared to furnish Industrial Control Equipment rated in excess of the above ratings, *which they guarantee* to be suitable for use at the assigned ratings. Authorities having jurisdiction should in all cases be consulted before such equipment is installed."

But the inspection departments having jurisdiction want to know *from the Laboratories* that the devices will be suitable and not from the manufacturers. And how are the inspection departments to know *which* manufacturers are prepared to furnish the larger devices? If the inspection department is to take the manufacturer's guarantee on devices for over 30 hp., why should they not take it on devices of 30 hp. and less and so why have Laboratories' listings at all?

The inspection departments generally have no facilities for testing the devices themselves nor time or facilities for comparing the specifications. This is supposed to be, and should be, the work of the Laboratories and we should have their listings of all devices. Why should any poor lone inspector be left "holding the bag".

Bonding and Grounding

Q. *"Kindly advise whether diagram shown below on grounding of meter and service equipment would meet Code requirements."*—L. T.


Service standpipe
Threaded
Meter
Threaded type conduiet
¾" galvanized pipe at least 8' in to ground with no grounding wire

A. An installation made in accordance with the above diagram would meet the Code requirements providing that proper bonding and grounding arrangements are made in the service equipment cabinet (not shown in diagram) and provided (see 2595-a) that the secondary system has at least one other ground at the transformer or elsewhere. In the service cabinet a bonding bushing and jumper would be required.

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By using Greenlee Timesaving Tools for bending conduit, enlarging knockouts, pulling cable, pushing pipe, and other operations, much can be accomplished in the way of efficiency and much can be done to insure more profits. But that isn't all. In most cases it means that better work will be done on each job.

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The rigid conduit bender, shown above, is made in two sizes for conduit from 1¼ to 3-inch and from 3 to 4½-inch. The smaller bender can also be fitted with a set of attachments for bending 1¼, 1½ and 2-inch thin-wall steel conduit.

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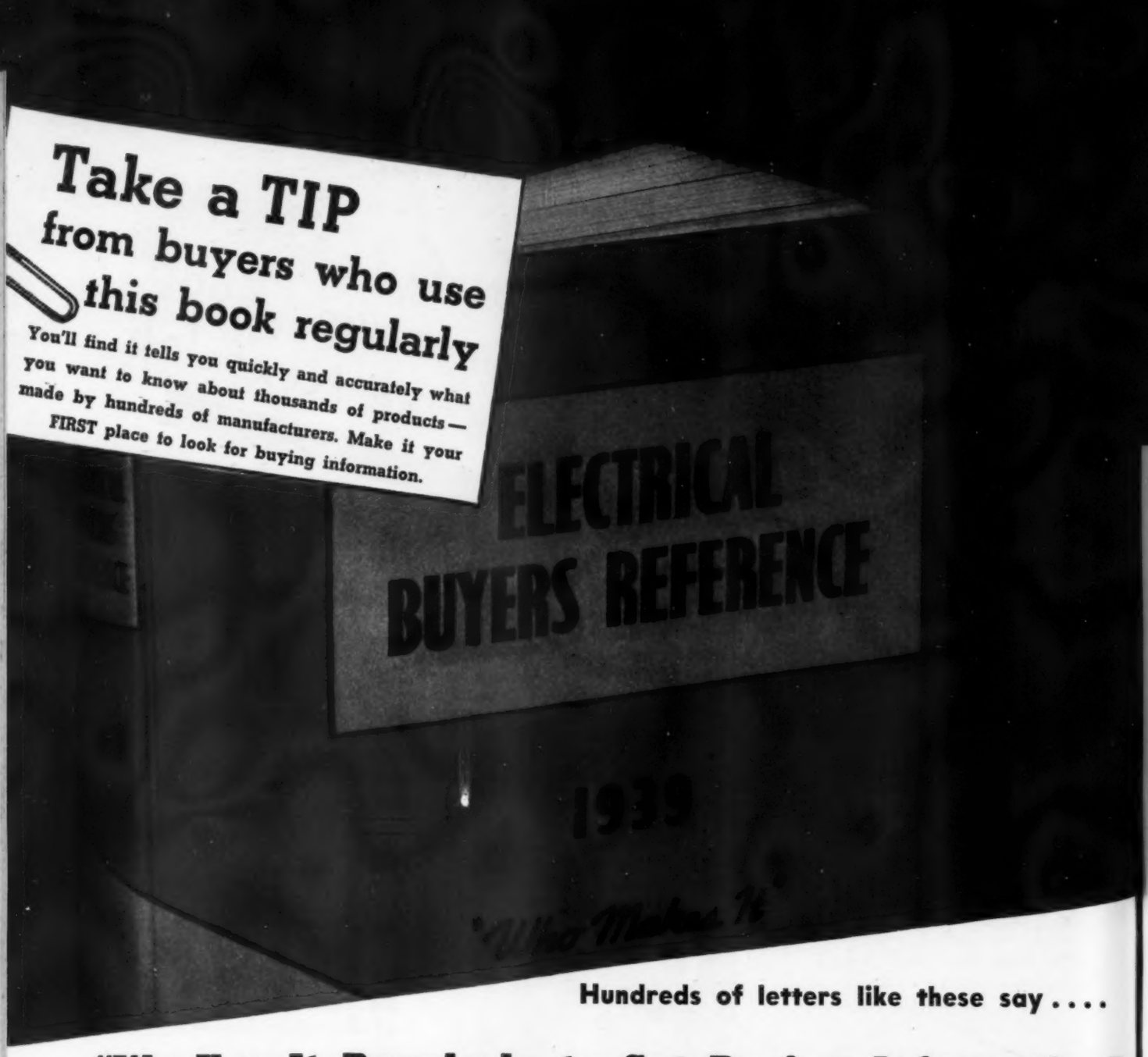
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1939

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Use It Every Day—"I don't know how I could get along without this book. We have been receiving it for a number of years and use it about every day . . . has everything in it that is needed"—a radio and electric shop in Sabetha, Kansas, sent this message.

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ELECTRICAL

Maintenance

INDUSTRIAL AND COMMERCIAL

AND THIS TIME —ABOUT TOOLS

ELECTRICAL maintenance men have a lot to do today about a plant that was not in the day's work a few years back. Take portable tools, for instance. These time savers are used in steadily increasing number along the production and assembly line, as well as by the maintenance staff itself. And because these tools get hard usage, they need care.

So a knowledge of electric tools is now vital to every member of the maintenance crew — how to select them, how to apply them, how to locate trouble in them, what goes wrong and how to correct it. Therefore, this Guide Sheet on Maintenance Practice talks tools. Read it and check your background, knowledge and the routine methods you now employ.

This series of articles began in January, 1938, with a frank review of the electrical maintenance man's job. Then came—

1. Alternating Current Motors—Types and Applications
2. Direct Current Motors—Types and Applications
3. Alternating Current Motors—Maintenance
4. Direct Current Motors—Maintenance
5. A.C. Motor Starters and Controllers—Types and Applications
6. D.C. Motor Starters and Controllers—Types and Applications
7. Maintenance of Control Equipment
8. Special Control Problems—Heavy Installations and Maintenance
9. Electric Distribution — Circuit Protection — Power Factor Correction
10. Lighting — Applications and Maintenance
11. Electric Heat—Types, Applications and Maintenance
12. Electric Welding — Types, Applications, Control
13. Interplant Communication —Types and Common Maintenance Problems
14. Instruments—Types, Application, Care
15. Power Tools — Types, Applications, Care (this issue)

Coming articles will discuss

16. Batteries and Rectifiers—Types and Maintenance
17. Electroplating — Maintenance Aspects
18. Electronic Devices—Types and Applications

POWER TOOLS

Types, Application and Care

PORTABLE electric tools are small in comparison with other machines in the plant, but power tools perform a service to industry and maintenance alike that makes them practically indispensable.

These tools have kept pace with the rapid development of present day production methods. They are built with the same degree of accuracy and precision as the finest machine tool. However, they are frequently the most abused tools in the plant.

So because of the wide-spread use of these tools, the electrical maintenance man must be prepared to keep them in operating condition. Therefore, the classifications of power tools, their selection, application, operation and maintenance is worth discussion.

A portable electric tool is essentially an electric motor equipped with a suitable work spindle for various accessories such as augers, abrasives, drill bits and saws. It is designed within limits for easy portability, and with construction features adaptable to portable handling and operating. The general classifications of power tools are:

(1) Assembly Tools—screw drivers. nut runners and tappers;

(2) Drills;

(3) Sheet Metal Shears;

(4) Abrasive Tools—disc and portable belt sanders, polishers; bench, portable and flexible shaft grinders; cut-off tools;

(5) Hammers;

(6) Saws.

Selection

Many individual tools, especially drills, are commonly rated according to working capacity. In their selection the following ratings must be considered:

Light Duty—Any tool with this rating is designed for intermittent service only. It is smaller than standard and heavy duty models, has less motor power, and a generally lighter and less rugged construction. Sleeve instead of ball bearings are used often on the spindles. The switches are lighter and the cable is of lower quality. Also the price is lower.

Standard Duty—Tools having a standard duty rating are the most popular and widely used models. They are built to stand the abuse of general purpose work, have ample power for momentary over-

FOR A DEFINITE JOB, *many types and sizes of power tools are available. This tool is used with suitable accessories for surfacing and sanding operations. (Black & Decker photo)*

INTO THE CONCRETE—A combination electric hammer and drill being used with a star drill to bore holes. (Independent Pneumatic Tool photo)

loads, and are the favorite models for maintenance work of all kinds.

The standard duty tool is a medium priced tool just as it is the medium in power and construction. The switch and cable are correspondingly better than those used on light duty models. Usually ball bearings are used on the armature and work spindles, and sleeve bearings on intermediate gear spindles.

Heavy Duty—A power tool with this rating represents "tops" in design and construction. The motor is large and powerful, and has considerable reserve power beyond what is needed to meet its rated working capacity. The switch, cable, gears, housing, spindles and other parts are larger and heavier. All spindles are mounted on ball or roller bearings.

The heavy duty model is designed and constructed for continuous duty service and is selected for production work. Also it is preferable for general maintenance work because its reserve power and heavier construction insures minimum repair expense.

Tools of special design or with suitable attachments are available for close-quarter, around-corner, or right-angle work. Accessories can be obtained for operations other than the original purpose of the tool.

Factors governing the selection of a portable electric tool are (1) work to be performed, (2) service expected of the tool, and (3) kind of material to be worked. An example for a drill is given in the chart on the following page.

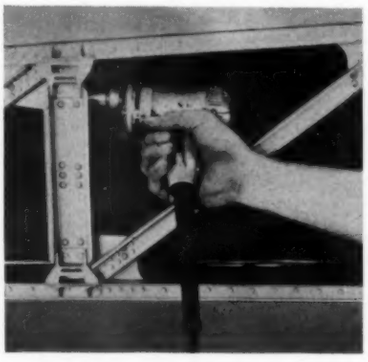
Sometimes there are limiting factors to be considered, such as close working quarters, depth of hole to be drilled, work "around corners," and tightness in screw driving and nut setting. In all cases the tool manufacturer should be given complete information on which to base recommendations for a particular task.

Other factors to be considered are—(1) manufacturer, (2) price, (3) service, (4) accessories, (5) motor power, (6) spindles, gears, etc., (7) lubrication, (8) ventilation, (9) switch, (10) cable, (11) chuck, (12) weight and (13) balance.

Applications

There are many types and sizes of power tools, each made to do a definite job. The names of the various kinds imply their use. With suitable accessories and attachments several power tools can be used for other operations; some are as follows:

1. *Drills*—for grinding, polishing, reaming and wire brushing.
2. *Grinders*—for buffing, polishing, wire brushing and sanding.
3. *Sanders*—for polishing, shaping, surfacing and wire brushing.
4. *Screw Drivers*—for nut running.
5. *Electric Hammers*—for drilling, chipping, and channelling in concrete, stone and brick; chiseling wood; removing scale, rust and paint; tamping concrete; and vibrating concrete forms.
6. *Portable Saw*—for wood and for cutting non-ferrous metals, compo and wall board. Abrasive discs can be attached to some saws.



"MIDGET" electric drill is suitable for close-quarters drilling as on airplanes, automobile body trim, radios and wood and metal furniture. (Chicago Pneumatic Tool Co. photo)

The electric drill is important for maintenance work. With suitable drill bits, augers, hole saws, and right-angle attachment, holes can be drilled in metal, wood and composition material. With wire brush wheel, paint can be removed and metals cleaned. A flare brush can be used for getting in corners and out-of-the-way places.

A portable grinder with several sizes of emery wheels and a wire wheel brush can be used in maintenance work. Some are available with flexible shafts. The shop should have a bench grinder, too, with a safety glass eye shield and an adjustable light fixture. Accessories should be available for buffing, polishing, sanding and wire brushing.

High-cycle tools are available to meet the demands of mass production operations. High-cycle tools are used when six or more can be installed. Power at 180 cycles, three-phase is supplied by a frequency changer set.

Operation

A portable electric tool is powered by an a.c. motor, or a d.c. motor, or a "universal" motor. Most motors are designed for operation on 110 volts; also they are available for operation on 32, 220, 250 volts, and special voltages, as well as for single-, two-, and three-phase circuits, and for frequencies from 25 to 60 cycles. The latter motor is designated "universal" because it will operate on either direct current or alternating current, single phase, and on any frequency from 25 to 60 cycles.

The universal motor is series wound, and has flexibility and high speed. The armature's high speed is an advantage, as for a die grinder. For another kind of tool such as a drill, the speed can be reduced through gear trains to a practical work speed that provides torque. Furthermore, the variable speed characteristic is an advantage. As speed decreases under load, torque increases to meet the load.

Portable electric tools, like other machines, are designed for efficient operation at rated capacity. Consequently, overloading and underloading of the tool are to be avoided. For example, any good electric drill can be used occasionally to drill holes over its rated capacity without harm, but if continuously overloaded, serious damage will occur soon.

On the other hand, using a large capacity power tool on light work is equally inefficient. A $\frac{3}{8}$-in. heavy duty drill does not have sufficient speed to operate effectively a small drill bit. This practice usually results in broken drill bits. A $\frac{1}{4}$-in. drill with proper speed will drill small holes about twice as fast as the larger tool, with practically no breakage.

A proper size bit should be used for drilling a specific size of hole. When using a small drill bit first and then

ATTACHMENT on the drill permits right-angle drilling between the upright pieces. (Van Dorn Electric Tool Co. photo)

ELECTRIC TOOLS – TROUBLE CHART – SELECTION – APPLICATION

Trouble-Shooting Chart

IF THIS HAPPENS	CHECK FOR THIS
New tool does not operate and is assumed to be defective.	Power line dead; blown fuse. Receptacle or plug not making contact. Either or both brushes not touching the commutator. Note — Dust may have settled between the commutator and the brushes, or the brush may be stuck in the holder, breaking the circuit.
Tool has been in service but motor does not operate.	Broken cable. Worn out brushes. Broken motor leads. Open circuit in armature. Open circuit in field coil. Switch not making contact.
Abnormal operation of motor — slow and jerky — excessive sparking at commutator.	Short circuit in field coil. Short circuit in armature. Open circuit in armature. Grounded.
Motor draws abnormally high current, and heats.	Short circuit. Note — This condition caused by failure of insulation between adjacent wires.
Operator sustains shock.	A ground — ground wire is not connected. Note — A ground may burn off the conductor at the point where insulation failed and cause the motor to show symptoms of open circuit. A grounded armature may go unnoticed until it develops an open circuit.
Open or short circuit at commutator.	Condition of commutator and brushes. Note — Dirt and metallic particles may make a definite short between commutator bars. Dust may have lodged between brush and commutator, breaking the circuit.
Armature fails.	Solder has been thrown out at commutator lead connections. Note — This condition always caused by overload or heat from violent flashing due to worn brushes, resulting in lessened spring tension on the brushes. A worn-out brush, or one of a grade not specified by the maker of the tool, puts the responsibility of such failure entirely on the user.
Motor heats.	Overloaded — voltage too high or too low; too much pressure put on tool cutting edge dull. Low voltage — at source; wire size too small in added extension cable. Note — Low voltage will definitely increase heating due to overload and reduced ventilation at lower speed.

Factors Governing Selection

FACTOR	GOVERNS
Work to be performed — Maximum diameter of hole to be drilled.	Size of tool and chuck rating.
Service expected of tool — Continuous or intermittent, severe or light.	Rating or model, such as light, standard or heavy duty.
Material to be drilled — Ferrous or non-ferrous metals, wood, composition, brick, concrete.	Chuck speed — in conjunction with size of drill bit to be used. Duty classification — in conjunction with service expected.

Application and Capacity of Typical Tools

TOOL	RATING	APPLICATION AND CAPACITY
¼-in. Drill	Light Duty Standard Heavy Duty	Drilling in Steel / Hard Wood ¼ in. / ½ in. ¼ in. / ½ in. ¼ in. / ½-1 in.
½-in. Drill	Light Duty Standard Heavy Duty	Drilling in Steel / Hard Wood ½ in. / 1-1⅜ in. ½ in. / 1-1⅜ in. ½ in. / 1-1½ in.
Hammer	½, ¾, 1⅛, 1½ and 2-in.	Average Concrete Drilling rates about 3 in. per min. with 1⅛-in hammer. Rate is less with larger hammer and greater with smaller hammer.
7-in. Sander	7-in. disc or suitable cup wheel	Metal, Wood and Concrete Area covered depends on condition of surface. Use normal pressure. Extreme pressure slows down motor, resulting in excessive wear of abrasive.

ELECTRIC SCREW DRIVER with suitable tool to run nuts. It can be used without bench stand for nut running or with a bit for driving screws. (Stanley Electric Tool Div. photo)

the larger bit, the first operation is drilling and the latter is reaming which overloads the motor. A power tool used on a heavy reaming operation should be operated at approximately 70 per cent of its drill rating.

In applications of tools using sand or abrasive discs, extreme pressure must be avoided otherwise the speed is reduced with resultant excessive wear of the abrasive disc. Speed for grinding with vitrified cup wheels is 5,400 surface feet (periphery).

Frequently tools are used that are very dull. But to do the job right, the operator must see that the correct cutting edge is used and that it is properly sharpened.

When a wire brush wheel or buffer, the same size as a grinding wheel, is used on a grinder, more load is put on the motor because of the hugging action; hence the pressure should be reduced about 50 per cent.

Portable electric tools can be operated on voltage that does not vary more than 10 per cent over or under the rated voltage on the name plate.

High voltage will (1) increase the speed, power input, and heating of the motor; (2) cause poor commutation, due to lack of continuous contact of the brushes with the commutator; and (3) possible damage to mechanical parts.

Low voltage will (1) reduce the motor speed; (2) cause overload of the motor, due to the reduction of power of the motor; and (3) definitely increase heating due to overload and reduced ventilation at lower speed.

Standard length cables vary from 7½ ft. on some tools to 25 ft. If tools are used at greater distances from a power outlet, cables with proper sizes of wires must be used to avoid excessive voltage drop. See chart elsewhere in this article. In all applications, tools should be "grounded" to prevent shock or injury to the operator.

Maintenance

Too much importance cannot be laid on periodic inspection of portable electric tools. Most small troubles can be corrected, preventing breakdowns and repair charges. So a systematic inspection schedule should be established. A maintenance record should be kept for each tool used in the plant. It can be in the form of a simple card file, that will insure inspection being automatic. A maintenance plan built around periodic inspection of all portable electric tools will result in prolonging their useful life and reduce maintenance cost to a minimum.

In order that power tools will be in satisfactory operating condition, the maintenance man should perform the following operations whenever a tool is inspected—

1. Clean out all accumulation of metallic dust, chips and dirt from, in and around motor, brushes and brush holders.
2. Thoroughly clean ventilating holes.
3. Clean or smooth commutator with sand paper.
4. Replace worn brushes, if necessary.
5. Check brush spring tension and see that springs are properly seated.
6. Tighten lead connections to brushes and brush holders.
7. Clean and inspect switch and tighten all connections.
8. Repair or replace broken cables.
9. See that attachment plug is in good condition.
10. Clean all accumulation of chips and metallic dust from chuck with gasoline or other suitable cleaning material. Immersion in oil for a few minutes will usually loosen tight jaws.
11. Inspect grease in gear case. Wash all worn-out grease from the case with suitable cleaning material.
12. Relubricate with lubricant recommended by manufacturer.

Remember that too much grease is as bad as not enough. The gear case of the tool should be filled approximately one-third full. Grease expands with heat, and if too much is used it will force its way through the bearings, getting into the motor and ventilating holes, and causing serious damage. Abrasive tools should be cleaned thoroughly and at more frequent intervals than other types of portable tools, because of the quantity of metallic dust which is usually in the air where these machines are used. The manufacturer has provided a means of protecting the motor from abrasive dust. Invariably some dust will get on the current carrying parts. It is necessary that the tools be cleaned thoroughly at frequent intervals, depending, of course, on the application.

A sufficient stock of the most frequently used parts—carbon brushes, brush plugs, brush holders, brush springs, switch parts, cables, chuck keys, screws, bolts—should be carried at all times, for emergency repairs, so that the tool can be put back into use quickly. Some users are equipped to make major repairs on their portable electric tools. Where this is the case, spare armatures should be carried in stock. But the best policy is to send all tools requiring such repair work to the manufacturer.

When not in use, power tools should not be thrown in a corner or put under a bench. The cable should be coiled and the tools stored in boxes or trays in a clean, dry place, preferably in the tool room.

A well made portable electric tool properly used and cared for will be efficient and trouble-free over a long period of time. Neglect and abuse reduce the life of the machine to perhaps one-tenth of its possibilities when properly used and cared for.

SIZE OF EXTENSION CABLE FOR PORTABLE ELECTRIC TOOLS

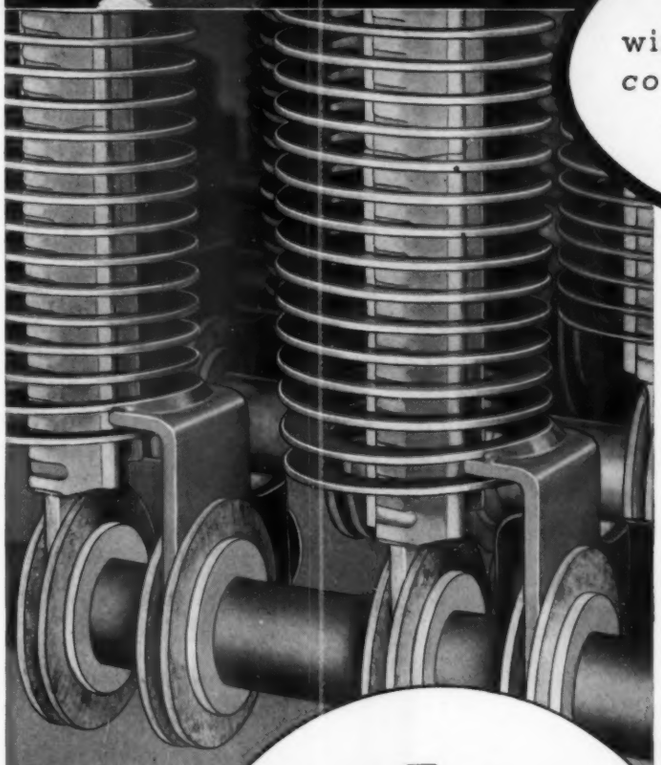
Based on current equivalent to 150 per cent of full load of tool and a loss in voltage of not over 5 volts.
This table for 110-volt tools. For 220-volt tools use wire size corresponding to an extension length of one-half the contemplated length.

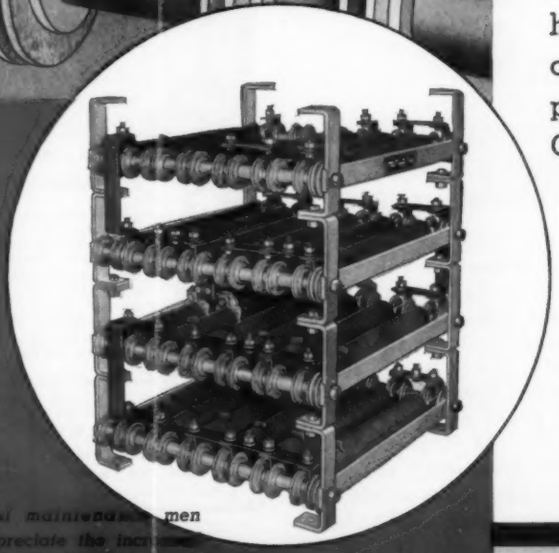
Full-load ampere rating of tool	0–2.00	2.10–3.4	3.5–5.00	5.10–7.0	7.10–12	12.1–16.0
Distance (one way)	Wire size (B & S gauge)					
25 ft.	18	18	18	18	16	14
50 ft.	18	18	18	16	14	12
75 ft.	18	18	16	14	12	10
100 ft.	18	16	14	12	10	8
200 ft.	16	14	12	10	8	6
300 ft.	14	12	10	8	6	4
400 ft.	12	10	8	6	4	4
500 ft.	12	10	8	6	4	2
600 ft.	10	8	6	4	2	2
800 ft.	10	8	6	4	2	1
1000 ft.	8	6	4	2	1	0

NOTE—If voltage is already low at the source (outlet), have voltage increased to standard, or use a much larger cable than listed in order to prevent any further loss in voltage.

They can TAKE IT and LIKE IT!

Clark "3C" Edgewound Resistors with welded terminals *provide constant, positive contacts. Expansion, contraction, vibration... can't knock 'em loose!*





Electrical maintenance men will appreciate the increased space which has been provided in the Clark "3C" Edgewound Resistor shown above.

● The resistor material is cold wound *on edge,* thereby withstanding shocks and vibration. • A cage form of resistor material protects porcelain insulators. • Corrosion-resisting! Mill resistance material is ADVANCE copper nickel alloy. All other parts are cadmium-plated. • Wider spacing between units provides easier accessibility and greater heat-dispelling areas. • Note the all-around, sturdy, light-weight, compact construction which enables Clark "3C" Edgewound Resistors to

"TAKE IT AND LIKE IT"

★ ★ ★

BALTIMORE • BIRMINGHAM • BOSTON • BUFFALO
CHICAGO • CHATTANOOGA • CINCINNATI
CLEVELAND • DALLAS • DENVER • DETROIT
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THE CLARK CONTROLLER COMPANY

1146 EAST 152nd STREET CLEVELAND, OHIO

FIBERGLAS*

- - - THE NEW INSULATING MATERIAL - - -

it is flexible—has high tensile strength—is resistant to deterioration at high temperatures.

We can now supply glass insulated magnet and motor lead wire; plain glass tapes, sleeving, and tying cords; "Vartex" varnished glass cloth and tapes; varnished glass sleeving; glass cloth; and mica sheet and insulating varnishes to be used with glass insulated motors. Send for our special bulletin containing full information on FIBERGLAS*.

*trade mark reg. U. S. pat. off.—Owens-Corning Fiberglas Corporation.

MOTOR REPAIR SHOPS CAN PROFIT BY USING THIS

INSULATION INCORPORATED CATALOG

For Ordering Wire And Insulating Materials

Highest quality, one organization you can depend on, quickest possible service on any amount—many Motor Repair Shops have known about these advantages for a long time and have been profiting by them. Try this service the next time you need magnet wire, Homer commutators, fibre, motor lead wire, varnished cambric cloth, capacitors, insulated paper, grey machinery enamel, maple armature wedges, carbon brush kits, and armature banding wire. Send for your copy of our catalog TODAY!

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INSULATION INCORPORATED
2127 PINE ST. ST. LOUIS, MO.

ORDER FROM

Headquarters

One Source of Supply for Wire and Insulating Materials

Quality - Dependability - Service

Constant Temperature at Low Cost

Electric unit heaters are used to keep a large aging cellar in a U. S. bonded warehouse at constant temperature of 72 deg. F. In this instance, steam and gas heating could not be installed economically.

CONSTANT TEMPERATURE *in aging cellar maintained by electric unit heaters.*

Windows were boarded over to preserve the insulating effect of the 8-in. brick walls. The units are placed strategically to distribute heat and provide an inexpensive means of maintaining the temperature.

Telephones for Mines

Q. *What type of telephones are used in mine installations?*—R. T.

A. Telephones, for use in mines where explosive gases are prevalent, should be of a type primarily designed for that purpose. In general, such telephones are of the magneto type, enclosed in cast metal housings, having tight fitting doors. Special features are provided as a guard against sparking of the switch-hook and generator spring contacts. Other precautions are taken to insure against loose contacts and connections in the instruments. The housings are designed to resist entrance of dust and moisture.

Telephones for service underground where there is no danger from explosive gases need not meet these stringent requirements. This is likewise true of instruments above ground, located in damp and dusty locations, not subject to

For Better Service-

INSTALL **TRICO** REG. U.S. PAT. OFF.

RENEWABLE FUSES
With the famous powder-packed element
KANTARK "ONE-TIME" FUSES
With genuine fibre tubes (not paper)
COLORTOP PLUG FUSES
Color tells the size
TRICOMATIC PLUG FUSES
With built-in thermal time-lag element
KLIPLOK CLAMPS
Lock fuses and clips together
TEST CLAMPS
For heavy duty testing
FUSE PULLERS
For safe handling of fuses
AUTOMATIC OILERS
For motors, line shafts, etc.

Send for your new Folder CPF-300 TODAY!

TRICO FUSE MFG. CO., MILWAUKEE, WIS.
In Canada—IRVING SMITH LIMITED—Montreal

TRICO POWDER PACKED FUSES

STOP WASTED KILOWATTS AND WASTEFUL SHUTDOWNS

The Fastest Cutting, Longest Wearing Drill Ever Introduced!

Drills Holes In Concrete, Tile, etc. 50 - 75% Faster!

•

Stays Sharp Up To 50 Times Longer

•

Reduces Installation Time For Expansion Anchors Easily 50%

No more hammering! No more chiseling! No more slow, costly methods of hole drilling! The new Carboloy Masonry Drill drills holes in concrete, brick, tile, slate, etc., 50% to 75% faster! Lasts up to 50 times longer! Holds sharp cutting edge for weeks of continuous use. Drills holes accurate "to the hair." It's the perfect drill for installing expansion anchors quickly, cheaply and easily.

Get the facts on this greatest time-saving, money-saving drill ever offered. Ask your dealer or pin cut below to your letterhead or postcard and mail today for free folder.

WRITE FOR **FREE LEAFLET**

Jobbers: Get details on special resale proposition.

The Mark of CARBOLOY REG. U.S. PAT. OFF.

CARBOLOY COMPANY, INC.
2857 E. Jefferson Ave. • Detroit, Mich.

CARBOLOY MASONRY DRILLS

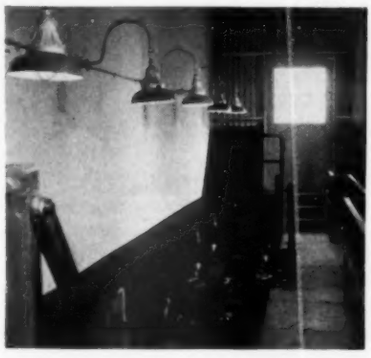
explosive hazards. These instruments should be of similar design, however, except for the non-explosive features. Telephones in buildings above ground where no explosive gases are present may be of the standard type designed to operate on the same circuit with the other instruments.

More Light Where Needed

With roof trusses so handy, it is perhaps natural for the plant engineer to rely on them for supporting light circuits. However, in many places this requires a long drop to bring the light close enough to the job, or the more expensive alternative of using excessive wattage to insure ample illumination on the working plane.

In a transfer pump room the lighting fixtures were originally suspended from the roof trusses and provided even illumination on the floor. But there was insufficient intensity to permit a quick check of the pumps, located close to the division wall. Considerable quantities of the more volatile fluids could leak without detection.

The first thought was to change the standard sockets to Moguls, so as to

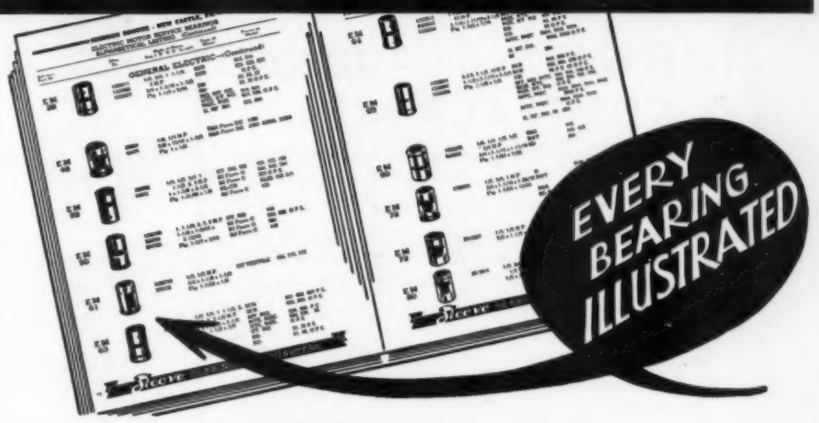


LIGHT WHERE NEEDED—Lighting units, moved from roof trusses to a place on the division wall just above the transfer pumps, were found to be suitable. Shifting of the fixtures permits better and quicker inspection of the machinery.

permit use of larger lamps than could be inserted in the original fittings. But Watson Turner, an electrical maintenance man for an oil company operating in Texas moved the lights from the trusses to the wall and directly above the pumps, concentrating the illumination over each unit. He tilted the reflectors just enough to spread ample light over the piping manifolds at the far side of the room.

Eyelets and wire harness to the top of the gooseneck drops carried the weight of the fixtures, and relieved the conduit outlets of unnecessary strain. With the shift, the original lighting

Write for this FREE book



JOHNSON
Leaded Bronze
ELECTRIC MOTOR
BEARINGS

● Here is the book that every electrical man should have. Seventy-two pages packed with interesting and valuable bearing information. In Electric Motor Bearings alone there are over 230 individual items — covering all types of motors in the various sizes from fractional horsepower on up.

Then, too, there is a listing of over 800 sizes of finished stock bearings; 350 sizes of bronze bars; Babbitt — both Tin-Base and Lead-Base;, together with much valuable application data.

And this book is offered free and without obligation. Simply mail your request . . . and a copy will go forward by return mail. Why not write . . . Today!

DISTRIBUTORS WANTED

If you sell electrical supplies then you can become a recognized Johnson Distributor. Here is an exceptional opportunity to handle a fast selling line — with a wide profit spread. Write today — on your business letterhead for complete details.

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Sleeve BEARING HEADQUARTERS
490 S. MILL STREET • NEW CASTLE, PA.

★

THE *SIMPLE* METHOD

TIME SAVING Appeals TO CONTRACTORS . . . .

Contractors find this simple method indispensable after one trial. No complicated installation troubles, no fussing with nuts to tighten, no lost time. The satisfactory results and the savings realized on each job is one of the reasons for the almost universal popularity. B-M Fittings are so reasonable in price that the savings on your first job will more than pay for the Indenter which is the only tool necessary to make a perfect installation. Ask your Wholesaler for details or write our distributors.

Our method and tools are patented and we limit the use of our tools under these patents to the installation of our fittings only.

COUPLING

TELESCOPE BM SYSTEM

CONNECTOR

No. 605

B-M INDENTER

Two squeezes on the handles of the B-M Indenter and the B-M Connectors and Couplings are securely fastened to the Electrical Metallic Tubing.

Distributed by
THE M. B. AUSTIN CO.
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Not Incorporated
GALVA, ILLINOIS

circuit could carry the load, ample illumination was obtained where needed, and the added expense of larger lamps and Mogul sockets was avoided.

Step-up and Step-down For Far-off Motors

How to supply current to a pump motor, located 3000 ft. from the main building of a Buffalo industrial plant, was a problem of the Sterns Electric Equipment Company. To have extended a pole line feeder from the 220-volt, 25 cycle, 3 phase power wiring system would have required three 250,000 cm weatherproof cables and 27 poles. This layout was abandoned for step-up/step-down 2200-volt transmission.

A bank of two 15-kva pole-mounted step-up transformers was installed at the main building. A 220-volt power feeder supplied these transformers, and a 2200-volt feeder consisting of No. 4 aluminum conductors, requiring but 13 poles, was run 3000 ft. to 2200/220 volt stepdown transformers near the small building.

To control this unusual circuit, a push button operated, magnetic main line contactor was used in the main building. The far-off 220-volt motor also has a magnetic motor starter, which has its contactor coil connected "hot". When the feeder is energized in the main building this remote starter automatically puts the motor on the line. Thermal overload relays at the motor starter provide overcurrent protection, and an integral stop button and main line switch allow maintenance men to shut down this motor at the pump, without the danger of someone starting it by means of the main building contactor.

Bunting Electric Motor Bearings not only assure the full-rated performance of the motor, but in many cases greatly lengthen bearing life.

Available from stock for all makes of motors from 1/50 hp to 100 hp, these Bunting Bearings afford the most economical and convenient service duplicates obtainable, as well as the most satisfactory . . . Write for catalog . . . The Bunting Brass & Bronze Company, Toledo, Ohio . . . Warehouses in All Principal Cities.

BUNTING Bunting **Quality**

BRONZE BUSHINGS • BEARINGS
PRECISION BRONZE BARS
BABBITT METALS

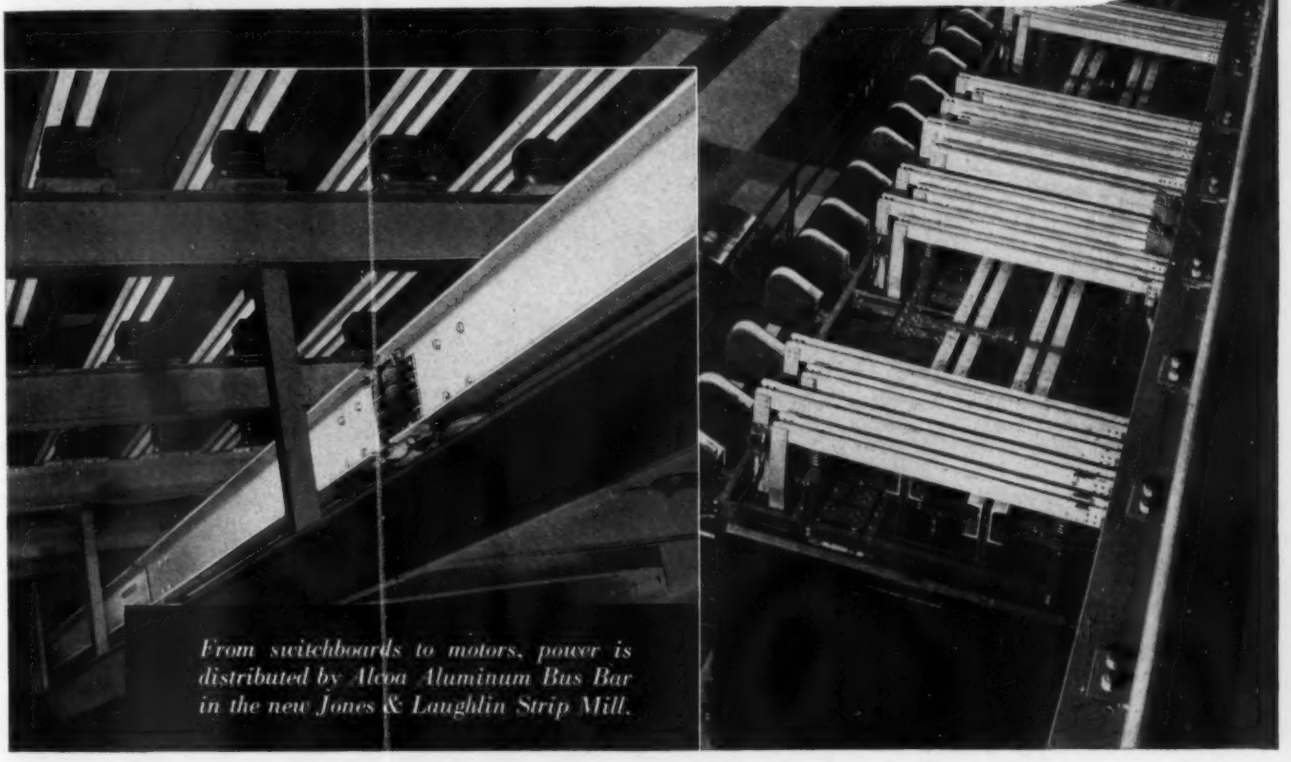
That Ventilating Problem!

Partial ventilation in summer is obtained by opening windows in most plants and offices. This method is impractical during the winter. But an adequate supply of fresh air can be furnished with electric ventilating equipment.

Motor driven exhaust fans can be mounted in small penthouses on the roof or inserted in windows in the room or department. The ventilating system must be designed for each installation, however, as a system that adequately serves one location may not be suited for another. Automatic thermostat controls should be considered.

EFFICIENT ELECTRICALLY—LIGHTWEIGHT AND STRONG

Alcoa Aluminum Bus Bar



From switchboards to motors, power is distributed by Alcoa Aluminum Bus Bar in the new Jones & Laughlin Strip Mill.

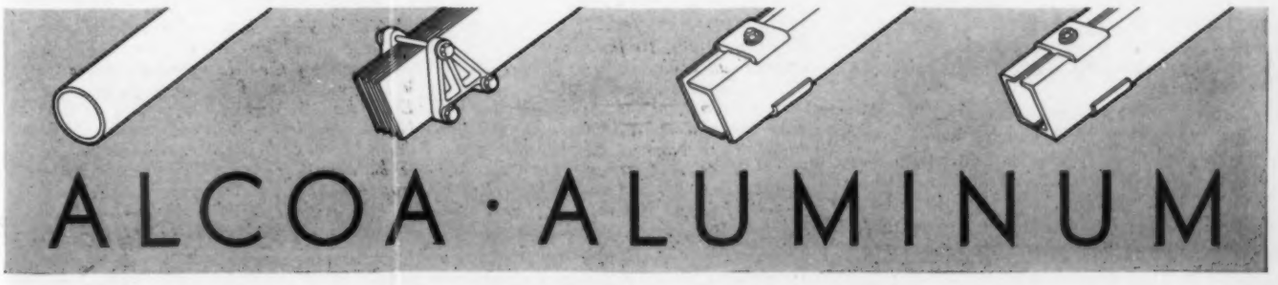
Electrical loads are heavy in the steel mill, with sudden rushes of current as motors are thrown across the line, plugged, reversed or stalled under heavy overloads. Alcoa Aluminum Bus Bar provides the current carrying capacity required for steel mill circuits and the strength to withstand the high strains imposed on these buses.

The lighter weight of Aluminum Bus Bar reduces the burden on structures supporting it. Supports can be lighter, cutting their cost considerably. Aluminum can be "tailored" to fit each individual job. Joints are made by bolting, or welding. Simple, inexpensive fittings are available.

Our engineers will gladly assist you in selecting proper Alcoa Aluminum Bus Bar to meet your requirements. ALUMINUM COMPANY OF AMERICA, 2197 Gulf Building, Pittsburgh, Pennsylyania.

* * *

"Make metal housings of Aluminum. It's non-magnetic, but easy to fabricate; sheet and structural shapes may be purchased from stock. Aluminum, though light in weight, makes housings strong and neat. It resists corrosion and retains a pleasing appearance in industrial atmospheres."



In the News

BOSTON TRADE SHOW TURNS 'EM AWAY

With every available booth space occupied, Boston's 1939 Electrical Trade Show provided a 3-day exhibit that attracted some 14,000 visitors. Sponsored by the Electrical Manufacturer's Representatives Club of New England for the sixth year, the arrangement and type of displays set a high standard in educational and commercial value. The show was held March 8, 9 and 10 at the Exhibition Hall in Boston Garden. There were 143 booths, which displayed the products of 400 or more manufacturers to visitors who came from Maine, New Hampshire, Vermont, Rhode Island, Connecticut and Massachusetts.

All branches of the industry were represented at this show, as well as plant executives, utility technical staffs and others interested in the diversity of new apparatus and materials shown. Because of well-organized publicity and promotion work, the New England area turned out to make each day a busy session for the exhibitors. Heavy representation was in evidence from utility companies, electrical wholesalers and contractors, service shops, plant superintendents and electricians, consulting engineers, inspectors and rating engineers, mill supply houses and equipment specialists.

No important items of modern electrical application or equipment were overlooked at this show. Elaborate displays and demonstrations of new lighting principles and equipment, motor applications, drives, coordinated control systems, distribution and protective devices were well represented. For heavy industrial construction and power companies there were also product displays of unusual interest. The latest materials for doing safe and adequate wiring in the home were given prominent treatment. Considerable space was devoted to new metering and service equipment methods for all sizes of customers. In other words Boston's sixth show had something new and interesting for every branch of the industry.

Credit for this year's successful Trade Show goes to a hard-working committee headed by James H. Sullivan. Charles A. Stone served as secretary of the Committee and handled the publicity for the show. The Electrical Manufacturer's Representatives Club of New England, who sponsored the show, is headed by H. J. MacDonald. S. H. King is vice-president of the club and Charles D. White is treasurer.

ST. LOUIS AWAITS SIXTH NISA SESSION

Service shops from many states will be represented at St. Louis on April 17, 18 and 19 for the sixth annual convention of the National Industrial Service Association. It is the big annual meeting for the men who engage in the repair, sales and installation of motors and other electrical apparatus. This three-day meeting will be held at the Jefferson Hotel. Convention arrangements are in charge of C. C. French of the French-Gerleman Electric Company, chairman of the convention committee, and Carl Christine of the St. Louis Electrical Board of Trade.

NISA COMMITTEE CHAIRMAN
Charles C. French reports the St. Louis electrical fraternity all set for service shop visitors from afar.

An interesting program has been arranged, which covers labor and insurance matters, overhead, shop practice and certification, cost discussions, new equipment and materials, and general industry topics. For the first time, an elaborate manufacturer's exhibit space will be provided near the convention hall. Here the latest in motor shop materials and equipment will be on display during the convention.

High spot in the program will be a discussion of the report just completed by the Trade Relations Committee, W. J. Wheeler, Chairman. Out of the experience of 50

AT BOSTON SHOW—The Sixth Electrical Trade Show held in Boston Garden March 8, 9 and 10 found lots of contractors present and interested. No. 1—James H. Sullivan chairman and Charles A. Stone secretary, of the Trade Show Committee. No. 2—Emery R. Cook contractor and Fred W. Barnes, supt. of fire alarms, came "up" from Portland, Maine. No. 3—H. J. Mac Donald (U.S. Rubber), president of Electrical Manufacturers Representatives Club. No. 4—Quincy men Michael Kuja, Alfred Fontana, and Norman Burrell stop at the Palmer booth with H. B. Forman (right) of Eagle Electric. Sorry we can't identify the badge-wearing exhibitor in the center. No. 5—Mass. Masters Booth—L. H. Barrowclough, Lynn; Charles T. Marsden, Lowell; Edward Bohaker, Fitchburg; John J. Reddington, Dorchester; and Wm. H. Hughes, Watertown, all delegates to the Massachusetts State Association of Master Electricians.

Steber LIGHTING SPECIALTIES

UTILITE No. 1

For use with the new Incandescent Projector Lamp (PAR-38) for *outdoor* and indoor service and with the new Reflector Lamp (R-40) for indoor lighting. Designed particularly for outdoor service.

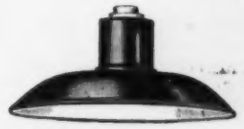
An ideal, all purpose, utility lighting unit, correctly designed, substantially constructed, portable and fully adjustable, easily installed—yet *low in cost.*

COVERLITES AND REFLECTORS

Outlet box mounting type. A high quality, process enameled reflector, outlet box cover and socket *all in one.* Keyless and pull-chain sockets. Particularly useful for low ceiling installations.

Porcelain or weatherproof socket mounting type. Slotted neck and strap holder, permanently attached to reflector. Rigid connection to socket—easily installed. Shallow dome and deep bowl, process enameled reflectors.

Brass shell socket mounting type. Reflector threaded to fit directly to socket. Sturdy connection—quickly installed. Shallow dome and deep bowl, process enameled reflectors.



Vertical and horizontal pipe mounting type. Process and porcelain enameled, shallow dome, deep bowl, and angle type reflectors all equipped with sockets.

OMNILITE FLOODLIGHTS

200 watt aluminum indoor floodlight complete with color screens. Substantially made, fully adjustable, attractively low in price. An exceptional value.

All-purpose outdoor and indoor floodlights. Five sizes, 60 watts to 300 watts. Complete with convex glass lens, fully adjustable bracket. Heavy gauge reflectors. Efficient, durable, inexpensive.

100 and 200 watt Floodlights. Heavy gauge, spun aluminum highly polished reflector. Complete with convex glass lens.
Durable, weatherproof construction for outdoor service. Similar units with color screens for indoor use.

500 and 1000 watt outdoor floodlights. Heavy gauge, polished reflector, with convex, heat resisting glass lens. Heavy cast aluminum mounting bracket. Highly efficient—a real quality-built floodlight.

YARDLIGHTS

Gooseneck brackets made of electrical metallic tubing. Complete line of shallow dome and angle type, process enameled reflectors. Durable, sturdy, pleasing design, easy to install.

Straight pipe bracket type. Complete line of process and porcelain enameled, shallow dome and angle type reflectors.

Gooseneck brackets and porcelain enameled, shallow dome and angle type reflectors.
All Yardlights are listed by the Underwriters Laboratories, Inc., and bear the Underwriters' Label.

The Steber line consists of useful and salable lighting specialties, which fill a definite need—*all quality products at attractively low prices.*

See your wholesaler or write us for complete catalog.

Steber MANUFACTURING COMPANY

126 NORTH UNION AVENUE **CHICAGO, ILLINOIS**

[FROM PAGE 160]

motor shops, the committee has tabulated the discounts required by its members to properly perform their functions as distributors under three different conditions as shown below—

	Min.	Max.	Weighted Average
Franchise Dealer, Exclusive Territory, Carrying Stock:			
Fractionals	24	40	40
1–200 HP	20	40	35
Over 200 HP..	15	37	25
Franchise Dealer, Exclusive Territory, No Stock:			
Fractionals	15	35	35
1–200 HP	15	30	30
Over 200 HP..	10	30	20
Broker selling any make of competitive equipment:			
Fractionals	10	25	15
1–200 HP	7.5	20	10
Over 200 HP..	5	17	10

By franchise dealer is meant a dealer who is aggressively promoting the sale of the products of a *single* manufacturer or of more than one *non-competitive* line of manufacture. In addition to an undivided allegiance in the promotion and sale of the manufacturer's equipment, it is assumed that a franchised dealer will furnish the manufacturer with an adequate sales engineering coverage and facilities for the prompt and efficient servicing of the types and sizes of equipment sold.

In the case of a dealer selling any make of competitive equipment (termed a Broker) the functions of sales promotion, engineering and servicing with the attendant facilities, personnel and investment are eliminated. Very naturally the broker operates at a substantially lower cost and requires a substantially lower discount.

A feature of the St. Louis entertainment program will be a visit to an old Mississippi show boat where visitors will see a play presented in the old river show boat tradition.

Highlights of the program include these interesting topics—

Monday—Overhead costs and hidden expenses. New shop practice and equipment. Certified repair shops.

Tuesday—Annual summary of rewind costs. Experiences with glass insulation. Unit cost vs. job cost.

Wednesday—Improvements in coil winding machinery. Trends in motor design. Motor controls.

The present officers of NISA are—president, John E. Launder, Kansas City, Mo.; vice-president, C. A. Sievert, Chicago; secretary, P. G. Winter, Indianapolis; executive secretary, S. N. Clarkson, New York; and treasurer, A. L. Brown, Worcester, Mass.

FLORIDA CONTRACTORS BOOST ADEQUATE WIRING

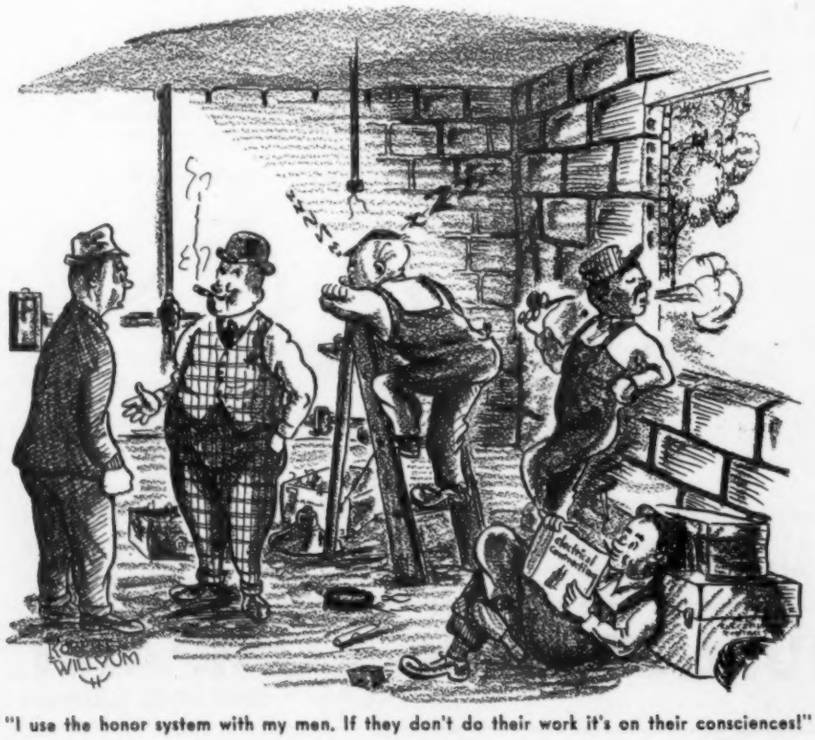
Adequate wiring and state legislation were the principal topics of discussion at the Orlando convention, March 5 to 7. More than 150 contractors and their ladies attended the meeting of the Florida Association of Electrical Contractors, held at the San Juan Hotel. Florida's proposed state licensing law was presented to the delegates and discussed in detail during two sessions. All branches of the industry were reported as being in accord with its provisions.

The presentation of adequate wiring was made before the convention by F. J. McGinnis, W. H. Davidson and A. C. Bergh, with equipment that had received unusual interest in various cities of the state. The unusual interest shown by the convention served to stimulate the zeal of contractors to take further part in this national promotion program.

Among speakers appearing on the program were: D. B. Clayton of Birmingham on "The Value of Cooperation," Laurence W. Davis on "Building a Solid Electrical Contracting Industry," and C. M. Ripley, "It Costs Less to Live Better."

Officers elected were—President, O. V. Scott, Miami; vice-president, Walter Monroe, Tampa; secretary, F. J. McGinnis, Palm Beach; treasurer, R. C. Bigby, Tampa; executive committee, W. O. Henderson, W. F. Jeffries, W. S. Shaw, Fred Stewart, R. A. Ragsdale and A. T. Wilson.

***TRAINING SIGHTS** on contractor delegates to the Wisconsin Electrical Association annual meeting, contractor Gordon Kummer of Milwaukee indulges his hobby of amateur photography. The ferocious machine is a speedgraphic with synchronized flash gun.*



"I use the honor system with my men. If they don't do their work it's on their consciences!"

REA STARTS IOWA CAMPAIGN

Beginning March 1st, some 8,000 farm customers of 10 rural electrification cooperatives in Iowa were to be subjected to an intensive appliance sales campaign. The objective is to make "five year's progress in 60 days" in appliance saturation. This experiment is being promoted and aided by the Rural Electrification, in the hope that a technique can be worked out to bolster revenues on its many projects throughout the country.

During the first six months of service, rural projects have realized only 48 per

Make the MOST of *Fluorescent Illumination* with

FLEX-O-LITE

TRADE MARK REG.

● Makes Possible a Wider Variety of Uses for Fluorescent Lighting ● Installs Easily ● Operates "Indefinitely" Without Replacements.

Why has The Industry given FLEX-O-LITE such an enthusiastic reception? Because such a marked advancement in illumination presents a profitable new source of revenue to every Electrical Jobber and Contractor.

Compare FLEX-O-LITE Tubular Lighting to conventional illumination and you can see that it offers ALL of the following Advantages—

● Cost of Installation and Replacement is Lower. FLEX-O-LITE does not require installation of costly additional equipment. The life of a FLEX-O-LITE Tubular Lamp is not limited by the use of filaments.

● Consumes Less Power — Gives More Light.

● Operates with Greatest Efficiency at a Far Lower Temperature. (Approx. 115-125 degrees)

● More Efficient for Either Practical or Decorative Lighting. FLEX-O-LITE Tubular Lamps are ideally suited to direct or indirect lighting. FLEX-O-LITE is available in DAYLIGHT WHITE or NINE other colors.

● Installs Easily. Standard FLEX-O-LITE Tubular Lamps are made in a variety of straight and curved lengths—easily installed with simple tools. You simply decide on the combination of FLEX-O-LITE Lamps for each installation, then ORDER DIRECT FROM YOUR JOBBER.

St. Charles Technical Laboratories, Inc.
R. A. Warren, *President* St. Charles, Ill.

MAIL COUPON TODAY
and you will receive your free copy of the booklet "Flex-O-Lite Facts" and complete specifications and details.

ST. CHARLES TECHNICAL LABORATORIES, INC.
St. Charles, Illinois

Please send me a free copy of "FLEX-O-LITE FACTS" together with complete specifications and details on FLEX-O-LITE.

Name .....

Company .....

Street .....

City ..... *State* .....

☐ Electrical Contractor ☐ Jobber

EC-4

GEDNEY IMPROVED FITTINGS

The Complete Line of Electrical Fittings

ADJUSTABLE BONDING BUSHING: Sizes—½" to 2".

Single-Double or 2 screw.

NEW GEDNEY CONNECTOR

FEATURES . . . Self-adjustable floating grip, assuring full gripping surface at any angle. Pressure is spread over wide area of the grip, giving a tight hold. DETAILS . . . Self-adjusting grip does not mar or cut insulation. Takes a wide range of cable sizes with maximum hold. Comes in one unit. Sizes —⅜" to 2".

LOCKNUTS: Sizes—⅜" to 6".

BUSHINGS: Sizes ⅜" to 6". Capped Bushings: Sizes—½" to 2".

CONDUIT COUPLINGS: —½" to 4".

H. D. GALVANIZED MALLEABLE IRON PIPE STRAPS: Sizes —¼" to 4". For Rigid-EMT-S.E. Cable.

CAPPED ELBOWS: Sizes—½" to 1½".

ENTRANCE CAPS: Sizes —½" to 4".

ENTRANCE ELBOWS: Sizes—½" to 2".

90° ANGLE CONNECTORS: Sizes—⅜" to 2".

GROUND FITTINGS for Rigid-EMT-Bare Armored - Unarmored-Solderless Bare-Insuled: For ground pipe sizes ½", ¾", 1" or 1¼" to 2".

EMT CONNECTORS AND COUPLINGS

Write for Catalog of the Complete Gedney Line.

Sole Sales Agent
HERON ELECTRIC SALES CORPORATION
30 Rockefeller Plaza
New York City

In the News

[FROM PAGE 162]

cent of their anticipated revenue, and after 18 months the average has climbed on up to 92 per cent. This is true despite the fact that low-cost financing has been available through the Electric Home and Farm Authority ever since the REA program started. How to accelerate this curve is the present problem.

Since each new project opens up a large concentrated market, REA has approached manufacturers, distributors, and dealers with the proposal that profit margins be reduced and sales efforts intensified in an effort to speed up the purchase of equipment. In the Iowa experiment, installed costs will be slashed by from 25 to 35 per cent to prove whether resulting volume will make up for lower margins.

The primary sales pressure will be on electric ranges, followed by refrigerators, mixers, lighting fixtures and other equipment in diminishing order. Cooking schools and demonstrations will be held at many points throughout the area, whenever possible with the cooperation of the local dealer, or newspaper. Although REA personnel will be prominently in the picture, there is no disposition to short-circuit the trade. If the Iowa experiment proves a success, most of the promotion work can then be turned over to private business when the plan is transplanted to other regions. REA has no desire to act as an appliance retailer if it can get satisfactory results by turning the task over to local dealers.

UTILITY SALES EXECUTIVES DISCUSS WIRING

Utility sales executives attending the Edison Electrical Institute meeting in Chicago on March 24, heard Henry J. Morton of the Detroit Edison Company discuss the problem of rewiring for increased loads in present commercial structures. This problem is of vital importance, he said, because electrical loads have been increasing at the rate of approximately 20 per cent per year while wiring adequacy has increased only about ½ of 1 per cent per year. Further increases in commercial loads are being blocked by the industry's failure to sell additional wiring, he said, and this failure is due principally to the high cost of rewiring present structures under existing rules and regulations.

Because utility salesmen must provide the impetus to rewiring activity, he continued, they must learn the technical aspects of wiring design and develop adequate and economical wiring systems with the cooperation of the local contractors. Fundamentals of adequate wiring, he said, were adequate copper, ready accessibility and reasonable safety at a price that makes wiring saleable.

Mr. Morton has been holding a series of conferences around the country with manufacturers, wholesalers, contractors and utility men in informal gatherings, promoting this idea and 60 utility companies are already engaged in local programs for providing more adequate commercial wiring. Utility technical wiring advisers he believes can, expedite local cooperative trial installations, gain effective cooperation with local inspectors toward a more liberal inspection policy and convince local labor representatives that cheaper wiring methods result in an increase in labor hours.

EDISON INSTITUTE PROPOSALS APPROVED

Article sub-committees of the Electrical Committee of N.F.P.A. have approved a new table of current carrying capacities for electrical conductors, "thin insulation" conductors for pulling into present conduits in existing buildings, the use of bare neutral conductors in wiring systems and covered neutral cable, popularly known as CNX, for residential wiring. If approved by the Electrical Committee of N.F.P.A., which meets in December, 1939, these new rules will become a part of the 1940 revision of the National Electrical Code.

Vigorously supported by utility groups, these changes represent a trend toward liberalizing restrictions on electrical wiring and less expensive wiring systems. Official report of the action of the sub-committees will shortly be transmitted to N.F.P.A. by the Article Committee chairmen.

COMING MEETINGS

Massachusetts State Association of Master Electricians—Annual Convention, Hotel Bradford, Boston, April 14–15.

National Industrial Service Association—Convention, Jefferson Hotel, St. Louis, Mo., April 17–19.

Ohio State University—Eighth Annual Welding Engineering Conference, Industrial Engineering Building, Ohio State University Campus, May 11 and 12.

National Electrical Manufacturers Association—Spring Conference, The Homestead, Hot Springs, Va., May 14–18.

National Electrical Wholesalers Association—Annual Convention, The Homestead, Hot Springs, Va., May 22–25.

Ontario Electrical Contractors Association—Hamilton, Ont., June 1.

Illuminating Engineering Society—Annual Convention, Los Angeles, Calif., August 21–25.

International Association of Electrical Inspectors—Western Section, Hamilton, Ont., Sept. 11–15; Southern Section, Asheville, N. C., Sept. 18–22; Eastern Section, Providence, R. I., Oct. 2–6.

National Electrical Contractors Association—Annual Convention, Bellevue-Stratford Hotel, Philadelphia, Pa., Oct. 9–12.

National Electrical Manufacturers Association—Annual Conference, Palmer House, Chicago, Oct. 23–27.

RURAL ELECTRIC SHOW IN MACOMB

Illinois electrical industry leaders concerned with the rural market staged a state electrical show in Macomb on February

MACOMB CONTRACTOR Charles Purdum (at left) set up an elaborate display of home appliances and fixtures. He also prepared a wiring materials display for the REA booth.

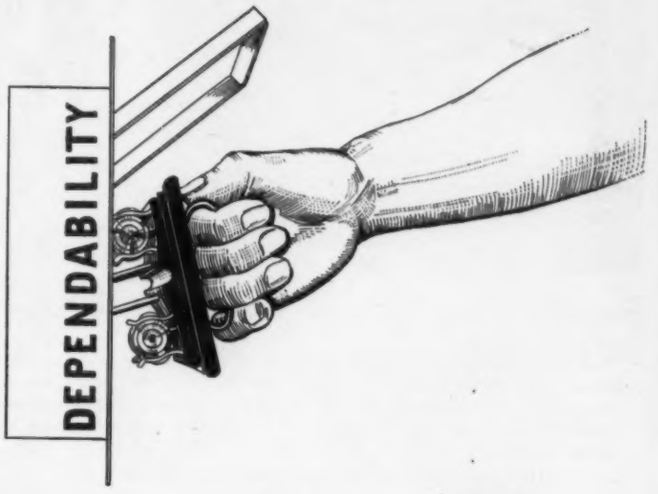
23 and 24 coinciding with the annual meeting of the State Farmers Institute in that same city.

Under the leadership of the McDonough Electrical Cooperative the Armory Building was portioned off into display booths for electrical dealers manned by officials prepared to answer questions regarding rural electrification. It is estimated that nearly a thousand visitors from throughout the state of Illinois attended the show.

ECHOS OF MANKATO *— (Above) Veteran Winona electrical contractor, H. B. Kline and Earl Whitehorne, editor of Electrical Contracting, examining one of the 150-watt floods displayed at the Mankato Convention of the Minnesota Electrical Contractors Association and its allied organizations. Below, W. S. Johnson of Duluth, retiring president, says, "Here's luck!" to Edward Karst of Fergus Falls who succeeded him as president. J. W. Hruska of Mankato, director of the Minnesota Electrical Council, took notes.*

Your QUALITY Specifications

are MORE than met • • • •

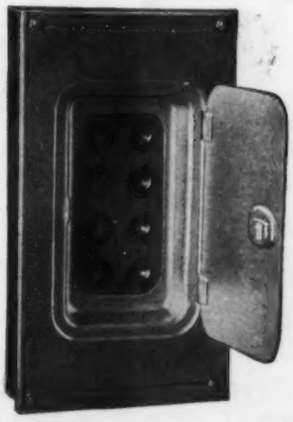


when you switch to

WALKER

Electrical Enclosures

Cat. No. W-415-V



Walker fuse panels, switches and enclosures are built to give you an *extra measure* of quality!

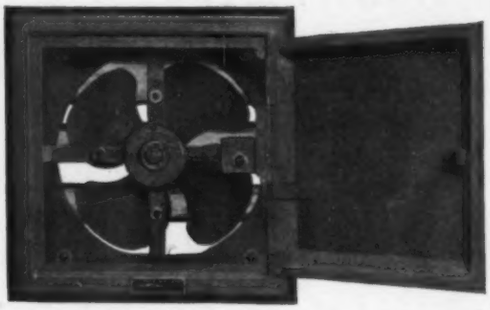
For every feature of best engineering practice, backed by over a quarter of a century of electrical contracting experience, goes into Walker products—they're designed to safeguard and build your reputation as a contractor or architect, through the extra long life of satisfactory, attractive service they give your customers.

Illustrated: Above, weatherproof pullout switch of pressed steel or aluminum for use where weatherproof main line switch is required for outdoor service. Watertight connections, spring hinged cover. Below, ultra-modern pressed steel or aluminum fusegroup, furnished for any number of circuits up to twelve.

Write for Catalogs Today!

WALKER
ELECTRICAL COMPANY
ATLANTA, GEORGIA

Here's the New SIGNAL AUTOMATIC WALL BOX . . . .



Kitchen VENT FAN

Only

For the Low Priced Field **$24.00 List**

A high quality kitchen vent fan for permanent installation . . . telescopic in design . . . made in sizes to fit walls from 7" to 24" thickness . . . easy to install . . . 10" quiet type fan that moves 500 cubic feet of air per minute . . . outside shutter frame is cast iron with aluminum weather-tight shutters . . . motor is rubber mounted . . . motor operates by opening and closing door.

Write for 1939 fan catalog, merchandising program, and prices.

SIGNAL ELECTRIC MFG. CO., MENOMINEE, MICHIGAN

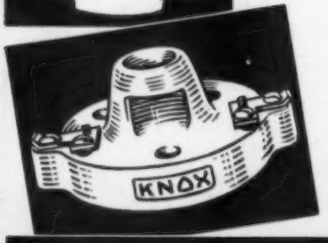
Offices in all principal cities

SIGNAL

THERE'S QUALITY IN KNOX WIRING DEVICES

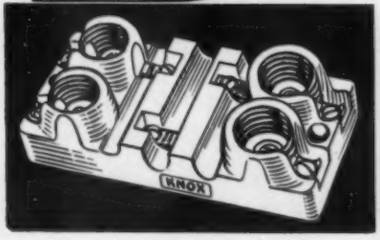
INSPECTED
TESTED
APPROVED

ROSETTES - RECEPTACLES - CUTOUTS
SOCKETS - PLATES - BUSHINGS, ETC.



The Knox line has been broadened from year to year until it is now the most complete available from any one manufacturer. It stands ace high with contractors, dealers and jobbers everywhere

KNOX PORCELAIN CORP.
KNOXVILLE, TENN., U.S.A.



In the News

[FROM PAGE 165]

A/W SWEEPS ON TO SECOND YEAR

The National Adequate Wiring Program now enters its second year of operation. A digest of reports received for 1938 operations indicate these impressive results that are being obtained—

Chicago—Over 1,200 A-W homes reported. The Electric Association awarded 571 certificates. A grand total of 34,913 outlets installed, with 5,000 added to original plans.

West Penn Territory—West Penn Power Company had 696 installations certified, 56.8 per cent over 1937. Applications for 326 jobs in progress carried over.

Cincinnati—Cincinnati Electric Association has accepted 666 houses. Some 1,554 outlets were added, including 84.2 per cent increase in lighting outlets, 87.6 per cent in switches and 145 per cent in convenience outlets.

Pine Bluff, Ark.—Arkansas Power & Light Company now plans to solicit orders for electrical contractors and run a sales campaign for additional duplex convenience outlets.

Youngstown, O.—The Electrical League of Youngstown is the twenty-first local group to undertake certification.

Dover, Del.—The Delmarva Electric Association has adopted the National Adequate Wiring Program.

Miami, Fla.—Meetings have presented the A-W Program in Fort Lauderdale, West Palm Beach, Cocoa, Sanford, Daytona Beach, St. Augustine, Palatka, Lake City, Madison, Bradenton, Sarasota and Fort Myers.

Indianapolis, Ind.—Plans are being set up with the Indianapolis Home Builders Association.

Omaha, Neb.—The Omaha Electrical League will conduct a prize contest for architects at the Building Show for the best electrically equipped home to sell at $5,500 or less.

Baltimore, Md.—Consolidated Gas Electric Light and Power Company of Baltimore, has an adequate wiring exhibit that shows the advantages of adequate wiring by switches, transparencies of six electrical appliances, a watt-meter panel and a fuse panel.

Milwaukee, Wis.—The Electrical League issued Certificate No. 1 to the Home Show Home, recently opened for public inspection. Fifteen or twenty additional homes will soon be ready for certification.

Southern California—The Electrical Development League of Southern California and the local chapter of the Producers' Council Club of Southern California dined 400 architects and structural engineers. Every branch of the electrical industry told its story.

Birmingham—Advertising for March and April includes 24-sheet poster billboards covering main arteries, service bill inclosures, direct mail follow-up of prospective builders of new homes with four mailings, and sound-slide film, "Power for Living."

New Castle, Pa.—Committee has licensed certification plan in Lawrence and Mercer

Counties, and portions of Allegheny, Beaver and Butler Counties, Pa.

Minneapolis, Minn.—The North Central Associated Electrical Industries is scheduling a "Spring Swing" on adequate wiring in fourteen trading centers in Minnesota.

Douglas, Ariz.—Have six model new homes under construction.

Wantagh, N. Y.—The Nassau-Suffolk Electrical Electrical Contractors' group to organize adequate wiring promotion in that area.

FORM NECA CHAPTER IN NEW BRUNSWICK

A chapter of the National Electrical Contractors' Association covering the province of New Brunswick (Canada) was recently organized at St. John. After formally receiving its charter, the chapter elected these officers: D. Rowland Webb, president; Frank P. Vaughan, vice-president; H. C. Lawton, secretary-treasurer; and H. A. Stephenson, George Mackie and N. E. Clarke, directors. All officers are residents of St. John, but it is the intention to campaign through New Brunswick province for members during this year. Indications are that several members of the board will visit the key communities in the province and confer with electrical contractors on joining the new chapter.

BIDDING BILL INTRODUCED

Senate Bill 1639, to require general contractors on public building projects to name their subcontractors in their bids, has been introduced by Senator David I. Walsh of Massachusetts. Under this bill, the subcontractor whose services the bidder intends to utilize to perform various parts of the work, would be listed in the general contractor's bid.

Every electrical contractor and local group that is interested in having this bill passed should write to its senators and representatives. The bill has been referred to the Senate Committee on Education and Labor. The members are: Thomas, Utah, Chairman; Walsh, Massachusetts; Murray, Montana; Donahue, Ohio; Holt, West Virginia; Pepper, Florida; Ellender, Louisiana; Lee, Oklahoma; Hill, Alabama; Borah, Idaho; LaFollette, Wisconsin; and Davis, Pennsylvania.

REA LOANS FOR WIRING

The following allotments have recently been made to finance rural house wiring and plumbing installations:

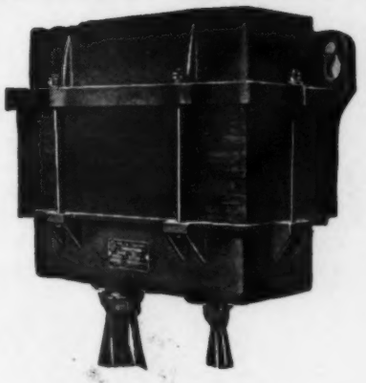
Iowa, $20,000 for customers in seven counties.

Kentucky, $15,000 for customers in four counties.

Michigan, $5,000 for customers in three counties.

Mississippi, $25,000 for customers in eight counties.

MERIT



Above: Type CFT, three-phase, outdoor-type, air-cooled, general-purpose transformer.

Below: Type CF, Single-phase, outdoor-type, air-cooled, general - purpose transformer.

Whenever it is desired to obtain a low-voltage supply from a higher voltage circuit you will find AmerTran Type "CF" Air-Cooled Transformers both economical and convenient to use. These moderately priced units may be installed wherever they are needed—either outdoors or indoors*—without the necessity of oil, fire-proof vaults or enclosures. All sizes are equipped with either conduit fittings or a built-in junction box to facilitate installation, and both single-phase and polyphase types are furnished as a single unit. Available in capacities up to 100 Kva. and for potentials up to 2400 volts, all ratings offer low initial investment, minimum installation and maintenance expense, and low operating cost. Let us send data on equipment to meet your needs. Ask for bulletin 1116A.

* Units rated 15 Kva. and larger for indoor service only.

Type "CF" Applications

1. Stepping down power circuit voltage to 115/230 volts for lights, small motors or heating elements. In this way advantage may be taken of lower power rates for low-voltage loads.
2. Obtaining a 3-wire circuit from a 2-wire system.
3. Changing from 3 phase to 2 phase, or vice versa, on a power sytsem.
4. Obtaining low voltage for heating, welding, 32-volt tools, special lighting, testing, etc.
5. Balancing load on 3-phase systems.
6. Insulating one circuit from another.
7. Distributing power at 600 volts or less.
8. Reducing light flicker.
9. Obtaining special voltages to permit efficient operation of equipment.

AMERICAN TRANSFORMER COMPANY

178 Emmet St. Newark, N. J.

PRODUCTS

American Transformer Co. manufactures transformers for every industrial, electronic and laboratory application in sizes up to 10,000 Kva and for potentials up to 132 Kv. Other products: voltage regulators, test sets, rectifiers.

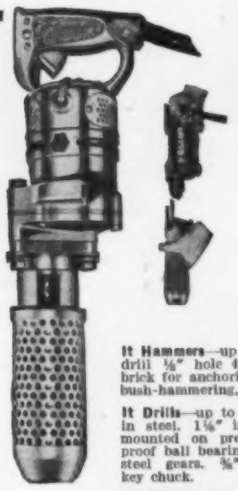
AMERTRAN TRANSFORMERS

Manufactured Since 1901 at Newark, N. J.

A "3-PURPOSE TOOL" THAT
CONTRACTORS HAVE DREAMED OF . . .

THE Milwaukee
HAMMER-DRILL

Cuts time and labor costs on more jobs

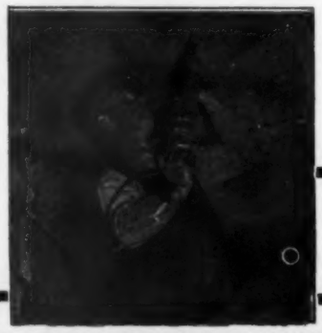


More jobs at larger profits on each—that's what this handy, fast-working tool will do for you. Full ball bearing construction. Furnished complete with sturdy, wooden carrying case. ⅜" Jacob chuck and key, special taper tool chuck one ½" star drill. 12-ft. 3-wire heavy duty rubber cable, and tool retaining spring. Universal motor for D. C. or A. C. 25, 40, or 60 cycles. Furnished with 32, 110, 150, 220, or 250-volt motor as specified. If your Jobber doesn't yet handle this widely used tool write us direct.

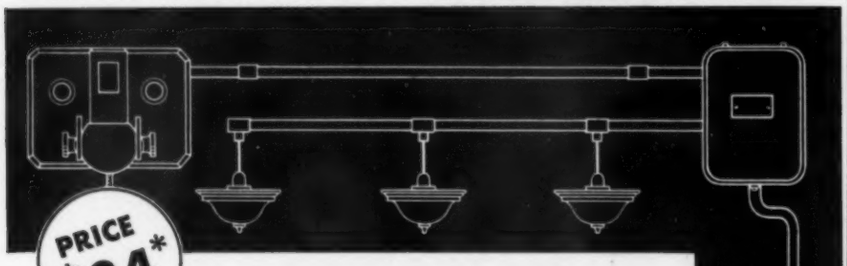
It Hammers—up to 1⅛" diameter holes in concrete when using a hollow drill. Will drill ½" hole 4" deep in one minute. Use it for drilling holes in concrete or brick for anchoring expansion bolts, for scaling rust, channeling, seaming, vibrating, bush-hammering, caulking, etc.

It Drills—up to 5/16" diameter holes in steel, 1½" in wood. Every shaft mounted on precision oil-seal, dirt-proof ball bearings. Helical cut, alloy steel gears. ⅜" heavy duty Jacobs key chuck.

It Grinds—sharpen your tools right on the job by using emery wheel with arbor to fit into chuck of electric drill. Easy, quick, convenient.



MILWAUKEE ELECTRIC
TOOL CORPORATION
106-109 N. WATER STREET
MILWAUKEE WISCONSIN



PRICE $34*

Increased Profits
with Automatic Light Control

Talk to your customers about General Electric automatic light control—it can help you sell lighting equipment. Explain to them that this new control (1) automatically turns lights on when daylight becomes dim; (2) automatically turns lights off when daylight returns.

It's an ideal way to open your talk on better lighting, correct luminaires, and adequate wiring. It will mean increased profits from (1) sales of the control, and (2) increased sales of associated equipment.

We have prepared a pamphlet that gives you more complete information on the value of automatically controlled light. Fill out the coupon for your copy.

GENERAL ELECTRIC

** Price includes photoelectric room unit and flush-mounted remote controller.*

General Electric,
Dept. 6—201, Schenectady, N. Y.

Please send me a copy of *G-E Photoelectric Relay for Automatic Light Control* (GEA-2679).

Name.....

Address.....

.....

680-170

In the News

[FROM PAGE 167]

Nebraska, $22,500 for customers in five counties.
New Mexico, $25,000 for customers in two counties.
North Dakota, $10,000 for customers in seven counties.
Ohio, $15,000 for customers in ten counties.
Texas, $51,500 for customers in nineteen counties.
Wisconsin, $5,000 for customers in one county.

MANUFACTURERS NEWS

New Sangamo President

Donald S. Funk, Vice President and General Manager of the Sangamo Electric Company, Springfield, Ill. was elected President and General Manager at the quarterly meeting of the Board of Directors. Mr. Funk succeeds the late Robert C. Lanphier as executive head of the company.

W. H. Taubert, for the past eight years Sales Manager of the Insulation Division, Corning Glass Works, Corning, New York, has joined the Phelps Dodge Copper Products Corporation in its Sales Department at New York.

Mark G. Mueller, agent for Ward Leonard Electric Co., has moved to 1644 Blake Street, Denver, Colo.

Frank L. Nason has been appointed New England district manager of the Westinghouse Electric & Manufacturing Co. His headquarters will continue to be at 10 High Street, Boston.

G. S. Alcorn, formerly assistant to the manager, has been appointed sales manager of the wiring device section of the General Electric appliance and merchandise department, Bridgeport, Conn.

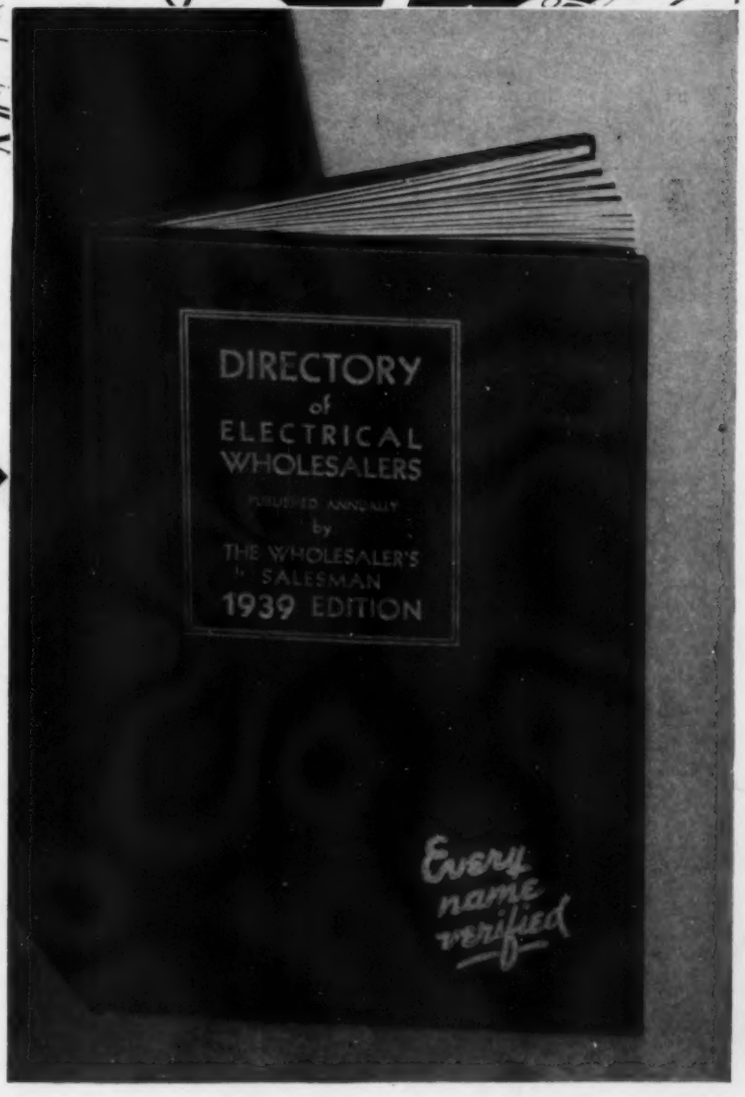
Roller-Smith Company, Bethlehem Pa., announces the appointment of James E. Bevan as assistant chief engineer.

The Alphaduct Products Co., formerly of Jersey City, N. J., have moved into new and larger quarters of Milltown, N. J. The new plant contains approximately 26,000 square feet of floor space.

The Standard Transformer Company of Warren, Ohio, has appointed the Industrial Equipment Co. as sales agent, covering the State of Texas east of a line through Wichita Falls, Abilene, San Antonio and Corpus Christi. The Industrial Equipment Co. has offices in both Houston and Dallas.

YOU CAN'T GO PLACES ON AN OLD TIMETABLE!

—AND you may miss real business without this up-to-the-minute 1939 DIRECTORY→



Like everything else, the electrical wholesaling field is changing—so rapidly, in fact, that over 80% of the listings in the 1938 Directory have been revised for the 1939 Edition.

One of the most valuable sales aids an electrical manufacturer can have is accurate, up-to-date information about wholesalers. Incorrect data is more than misleading—it can cost money in lost sales and misdirected effort.

Order a copy of the 1939 Directory today, and profit from having *facts* when and where you want them.

A Service of WHOLESALER'S SALESMAN • 330 W. 42 ST., NEW YORK

$15.00 for First Copy. $7.50 for Additional Copies to Same Manufacturer

EQUIPMENT News

GOODRICH FLUORESCENT FIXTURE

Lighting Unit

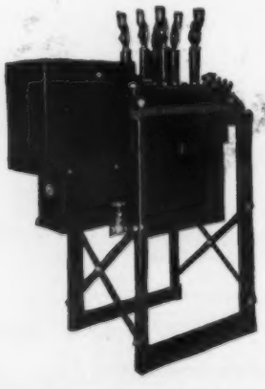
The Re-Mo-Lite is a remote-controlled lighting unit. Circuit is controlled from a one-wire service over 110-volt service. Control is adaptable for any standard yardlight and comes complete with two switches, lag bolts, service screws. Handles any number of switches on same service, which means any number of switches for yardlights at any point. Recommended for rural and industrial lighting jobs. Twentieth Century Engineering Co., Mankato, Minn.

TWENTIETH CENTURY RE-MO-LITE

■

Circuit Breaker

A new indoor oil circuit breaker with 100,000 kva. interrupting rating. Incorporates single port cross blast principle with heavy duty, butt type, arcing contacts and silver to silver main current carrying contacts. For use in steel mills on feeders, motors, incoming lines, and at other places where frequent operations are necessary. The breaker may be operated either electrically or manually. General Electric Co., Schenectady, N. Y.



G-E CIRCUIT BREAKER

BENJAMIN "EQUALUX" REFLECTOR

Reflector

A 200-watt reflector known as "Equalux" because it equalizes illumination over a definitely restricted area. Unit was developed for use in textile industry but there are many other applications in industry which suggest other uses. In loom lighting applications reflectors are located directly over each loom to eliminate weaver's shadow. Provides vertical illumination for servicing and repairing looms, with intensities above 70 footcandles in middle of area and more than 40 footcandles at extreme outer edges. Benjamin Electric Mfg. Co., DesPlaines, Ill.

■

TRUMBULL COMBINATION SWITCH

Range and Entrance Switch

An improved 60 ampere combination range and entrance switch, No. 2924-4, is more compact in design and easier to wire. Finished in aluminum both inside and out. Surface type provided as standard, with separate fuse door hinged to front, making possible a semi-flush installation. Trumbull Electric Mfg Co., Plainville, Conn.

Fluorescent Fixture

A new type fluorescent fixture to provide daylight illumination for inspection, drafting, color matching, etc. Available in two sizes to accommodate 18-in. and 36-in. flourescent lamps. Fixtures can be mounted singly or in parallel or linear rows. Fixture is finished in three coats of permanent porcelain enamel, white inside. Goodrich Electric Co., 2900 N. Oakley Ave., Chicago, Ill.

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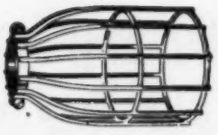


McGILL LAMP GUARD

Lamp Guard

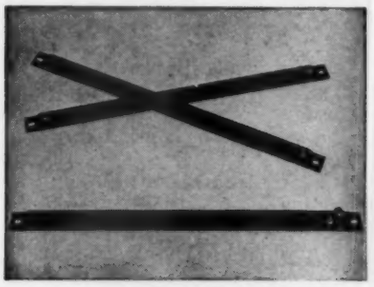
The New "Protector O" heavy duty lamp guard is designed for heavy construction work. Recommended for temporary installations on scaffolding and framework, as it can be removed and taken to next job. Cage is made of No. 10 wire with tinned finish, and reinforced with ring midway between collar and open end. Collar is normally open to slip over weatherproof sockets. Available in two sizes; No. 14332 for 60 watt lamp; No. 14333 for 100 watt lamp. McGill Manufacturing Co., Valparaiso, Ind.

■

Strip Heaters

Two new types of strip heaters designed to produce fast, economical heat. Made in temperature ratings of 750°F. and 1200°F. on the sheath, these heaters are applicable on crane cabs, valve house, elevators, ovens, metal water tanks, pipe lines, hydrants, hot table, metal moulds, foundry platens. Available either with terminals both at one end or at opposite ends for installation convenience. Heating elements have refractory insulation and are sealed against moisture, completely enclosed, with bolt holes provided at each end. Available for operation on 115

volts, 230 volts and two styles for 250 volts. Heaters include sizes 8, 12, 18, 24, 30½, 36 and 43 inches in length, with ratings from 150 to 1250 watts. Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

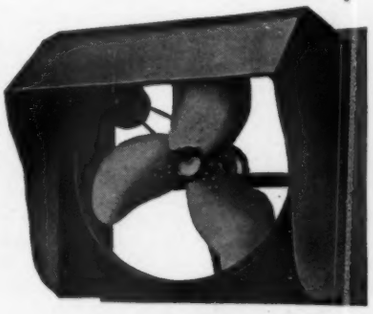


WESTINGHOUSE STRIP HEATERS

■

Apartment Cooling Fan

A cooling fan for apartments or homes without attics. Finished in weatherproof light gray enamel, permitting easy repainting to suit individual taste. Fan blades are all steel. Frame is all steel welded. Motors have special starting windings cutting down the inrush of current to start fans slowly. Thermal overload electric protection. Available in 24 and 30 inches. Chelsea Fan & Blower Co., Inc., 370 West 15th Street, New York.



CHELSEA APARTMENT FAN

■

Flexible Insulating Tubing

The Surco-Soflex line of flexible tubing is especially recommended for use in motor repair shops. Made in sizes from .50 to 13 m.m. (about 1/64 to 33/64 inches) in nineteen standard colors. Specially processed of vynil, this tubing contains no rubber, cotton, free carbon or sulphur. Dielectric strength of 750 to 1000 volts per mil and tensile strength of 1800 to 2400 lbs. per sq. in. are claimed, also remarkable physical, electrical and chemical properties. Held to be oilproof, ozoneproof, non-ageing, it resists oxidation and moisture and is unaffected by acids, alkalies, organic solvents and other chemicals which destroy ordinary insulation. Will withstand temperatures to 300 deg. F. and maintain its flexibility, elasticity and dielectric strength. Suprenant Electrical Insulation Co., 84 Purchase St., Boston, Mass.

For such operations as inspection, color matching, sorting, drafting and many others, the fluorescent lamp brings you the qualities of natural daylight in which human vision is at its best. Its cool light permits comfortable, close mounting.

FLUORESCENT FIXTURES
by Goodrich

Offered in three sizes for 18", 24" and 36" fluorescent lamps, these fixtures may be mounted singly, or in parallel or linear rows to answer a wide variety of lighting needs. Finished in permanent porcelain enamel, Goodrich fluorescent fixtures combine an unusually high factor of reflection with proper diffusion of light. Write us for catalog sheets.

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GOODRICH
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OFFICES IN ALL PRINCIPAL CITIES

GENERAL OFFICES AND FACTORY: 2902 N. OAKLEY AVENUE, CHICAGO, ILL.

TONG TEST AMMETERS

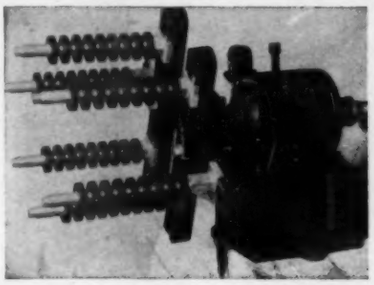
The Tong Test Ammeter is a compact 2¾ pound instrument with quickly interchangeable meter dials to accurately measure A.C. or D.C. up to 1,000 amperes. It contains no windings, so cannot burn out and because readings are made instantly and without interruption to service, hundreds of contractors use it to check circuits and equipment, to spot overloads and to save their own and their customers's time and money.

A Tong Test and Voltor attachment for voltage measuring should accompany you on every job. Judge this for yourself. Write for the bulletin describing them, or ask for a demonstration, today.

COLUMBIA ELECTRIC MFG. CO.
4501 Hamilton Ave. Cleveland, Ohio

IDEAL Coil Winding Equipment

A Complete Line For The Modern Repair Shop



NOW—Five sizes of *Ideal* Coil Winder Heads are available—a complete line—for winding many sizes and types of field, mush, armature, transformer, motor coils, etc.

FEATURES—Requires only three minutes setting-up time—coils laced, taped or tied while on head—quick reading scales for any thickness or size coil.

Ideal Coil Winder Heads attach to any lathe or turning device—especially suitable for *Ideal* Coil Winder Drive.

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See Our Products on Display N. I. S. A. Convention St. Louis, April 17-19

IDEAL COMMUTATOR DRESSER CO.
1041 Park Ave. Sycamore, Illinois

Just Published

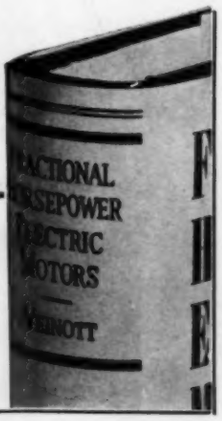
FRACTIONAL HORSEPOWER ELECTRIC MOTORS

What Kinds Are Available — What Makes Them Run and What They Will Do — How to Repair, Rewind, and Reconnect Them

By CYRIL G. VEINOTT
Design Engineer, Small Motor Engineering Dep't
Westinghouse Electric & Manufacturing Co.

431 pages, 314 illustrations, 22 tables, $3.50

HERE is a new book, so complete, so competent, so practical, that it will serve you as a thorough and dependable textbook and manual. It is for everyone engaged in the manufacture, use, or servicing of fractional horsepower motors, regardless of how much or how little technical training he may have had. Look up in this fact-packed book the specific *service problems* discussed in connection with 18 major types of motors; the excellent chapter on *testing methods;* and the many handy tables.



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McGraw-Hill Book Co., 330 W. 42nd St., New York

Send me Veinott—Fractional Horsepower Electric Motors for 10 days' examination on approval. In 10 days I will send $3.50 plus few cents postage, or return book postpaid. (We pay postage on orders accompanied by remittance.)

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Company .....E.C. 4-39

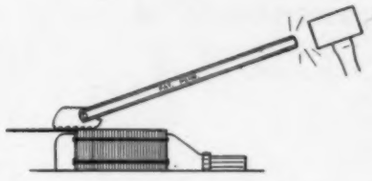
(Books sent on approval in U. S. and Canada only.)

EQUIPMENT News

[FROM PAGE 171]

Coil Wedge Remover

A time-saving tool for service shop mechanics, for use in removing or driving in coil wedges. A saw-toothed pivoted blade grips wedge surface in armature or stator slot as swivel arm is tapped with hammer. Each tap tends to create a firmer grip on stubborn wedges. Blade is 1/16-in. thick to fit narrow or so-called closed slot winding jobs, which makes this tool helpful for a wide range or armature or stator rewinding work. Mechanics quickly learn to remove wedges with ease and without damage to insulation. Pacific Electro Mechanical Co., 1129 West 19th St., San Pedro, Calif.



PEM WEDGE REMOVER

■

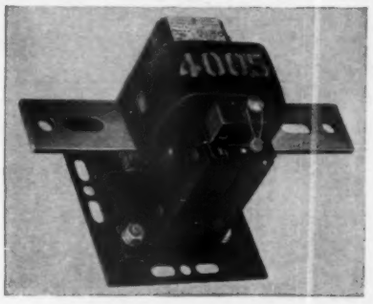
Brake

A new a.c. torque motor operated brake for service on elevators, cranes, hoists and similar installations. Designed for applications where positive, quick "cushioned" braking is required for stopping or holding load. When brake is released, torque motor is stalled across the line. When circuit is opened, torque spring sets brake. Available in five sizes, providing maximum torque ratings of 160, 400, 800, 1600 and 3200 lbs. ft. on intermittent duty. Continuous duty ratings are slightly lower. Available for all commercial frequencies and voltages. Cutler-Hammer, Inc., 228 North 12th St., Milwaukee, Wis.

CUTLER-HAMMER BRAKE

Transformer

A new indoor current transformer designed to combine advantages of small size with high accuracy for metering on low voltage circuits. It is designated Type JL-1, rated 600 volts and offered in three current ratings; 200/5, 400/5, and 600/5 amperes. Primary windings permit continuous operation at 150 per cent of rated primary current. Primary terminal surfaces are silver-plated and secondary terminals are solderless type, easily operated with a screw driver. Removable mounting plate permits mounting transformer on pipe. General Electric Co., Schenectady, N. Y.



G.E. TYPE JL-1 TRANSFORMER

■

Charge Control Unit

The Exide Charge Control Unit, Model MP, for users of battery-operated industrial trucks. Designed for use in recharging regularly-cycled storage batteries used in motive power service. Unit consists of a metal case, 11-in. by 10-in. by 5-in., containing relays, synchronous motor-driven time switch, signal lamps and connecting terminals. The control knob on unit is set without determining extent of previous discharge. The white signal lamp shows that the battery is on charge. When charge is complete and circuit automatically cut off, a green light signals that the battery is completely recharged and ready for use. The Electric Storage Battery Company, Allegheny Ave. and 19th St., Philadelphia.

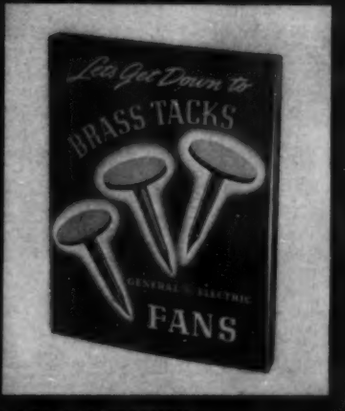
EXIDE CHARGE CONTROL UNIT

A product of the General Electric Company for more than 45 years, General Electric Fans are known the world over for their high-quality construction, efficient operation, and long life.

And because General Electric Fans are dependable, we back them up with what we believe to be the most liberal service policy in the fan industry—a service policy that provides immediate and free replacement of any G-E Fan found defective in material or workmanship during the warranty period.

Carry General Electric Fans this year and enjoy the profit opportunity extended you by the best known and most complete line of high-quality fans in the industry. You go for them—and they'll go for you!

Have you seen the unique G-E Fan Portfolio, "LET'S GET DOWN TO BRASS TACKS"? The salesman of your nearest General Electric Fan Distributor has a copy. Ask to see it when he next calls. You'll find it chock-full of sound advice!



APPLIANCE AND MERCHANDISE DEPARTMENT
GENERAL ELECTRIC CO., BRIDGEPORT, CONN.

GENERAL ELECTRIC

Every phase of electrical maintenance and repair work covered in this *new* Library

5 volumes of practical how-to-do-it information

Every man concerned with the care and repair of electrical machinery should have these practical books, with their helpful tables, diagrams, data, methods and kinks. Every one of the five volumes is jammed to the covers with sound, how-to-do-it information—the kind you have to have when anything goes wrong. Liberal use has been made of practical data and practice in repair shops so as to combine the good features of a library of methods with handbook information covering these methods.

Electrical Maintenance and Repair Library

5 volumes—2042 pages—1721 illustrations

IN these books will be found answers to practically all the repair and winding problems that the electrician will meet in actual practice.

The books discuss direct and alternating current windings—repair shop methods for rewinding armatures—commutator connection—the testing of armature windings—the testing of induction motors for faults—practical ways of reconnecting induction motors—commutator repairs—correct brush troubles, etc.

They tell you how to inspect and repair motor starters and generators—how to diagnose motor and generator troubles—how to figure new windings for old cores on induction motors.

You learn about three-wire systems, starting rheostats, transformers and starting polyphase motors, etc.

They give you scores of practical methods used by electrical repairmen to solve special problems.

New trouble-shooting and repair book now included in Library

Now, in addition to four well-known practical books on all details of testing, connecting, rewinding, installing and maintaining electrical machinery, the Library of Electrical Maintenance and Repair includes Stafford's *Troubles of Electrical Equipment*, a new book full of helpful maintenance information special trouble-shooting charts, explanation of symptoms and causes of machinery troubles, specific remedies, etc. This revised library helps you to know the why as well as the how of electrical maintenance and repair work, gives you the ability to handle bigger jobs with surety of results.

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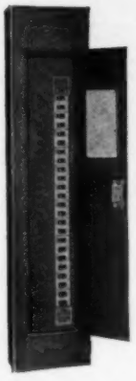
(Books sent on approval in U. S. and Canada only.)

EQUIPMENT NEWS

[FROM PAGE 173]

Multi-Breaker Panel

Type LX multi-breaker is designed to meet special lighting panel requirements of the industrial field. Fits into recesses of H-beams. Available in two sizes for either 8-in. or 10-in. beams. Circuit breakers are type M multi-breakers and can be furnished in single and double pole branches up to 50 ampere capacity. Available for either 3 or 4 wire a.c. service. Trim is hinged to box and held closed with screws. Narrow door is provided with lock and hinged to trim. Square D Company, Detroit, Mich.



SQUARE D MULTI-BREAKER PANEL

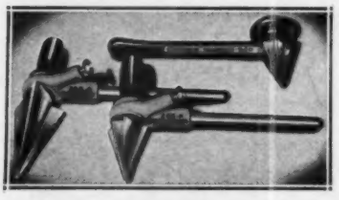
COFFING CHAIN HOIST

Chain Hoist

The new Power Master chain hoist is for industrial use. Features are controlled gravity lowering, free chain for quick up-or-down load chain adjustment, lubri-sealed ball bearings, with planetary gear system sealed and running in oil. Equipped with special diamond chain and built in capacities ranging from one ton to eight tons, with unit weights as low as 86 pounds for the 1-ton and only 169 pounds for the 8-ton. Coffing Hoist Company, Danville, Ill.

Reamers

These reamers have no inserted blades to work loose. Cones are drop-forged out of solid block of alloy-tool steel. Can be resharpened over and over again. No. 200 (Swivel) and No. 200-R (Ratchet) use the same ½ to 2-inch reamer cone. No. 300-R (Ratchet) uses a long, lean tapering cone which is designed to get up inside of pipe and clean out burr. Beaver Pipe Tools, Inc., Warren, Ohio.



BEAVER PIPE REAMERS

■

Switchmatic Pull Arm

A new "Switchmatic" extension pull arm for both canopy switches and holder receptacles to extend pull cord beyond the globe. Permits operation of either switch, or receptacle, and eliminates jarring and swinging of entire unit. Easily attached to any type of fixture. Canopy type is finished in plated statuary bronze or cadmium, holder is finished in cadmium only. Eagle Electric Mfg. Co., Inc. 57 Hall St., Brooklyn, N. Y.

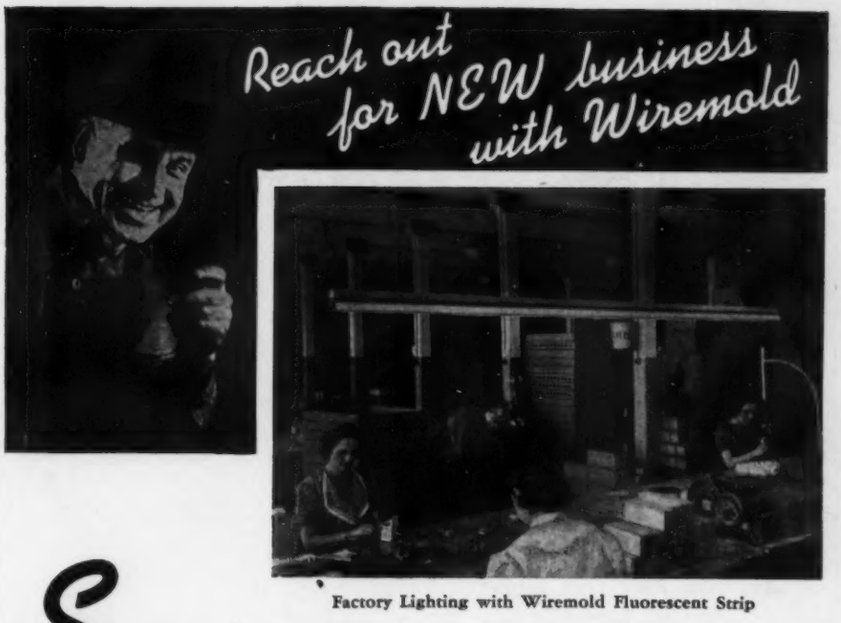
EAGLE PULL ARM

■

Auxiliary Projector

Spotlight No. 41-R that attaches to ceiling fixture by screwing bracket arm to ceiling under canopy. Fixture circuit is tapped under canopy and projector wire leads through canopy knockout. No new wiring required. Finished in satin chrome. Color caps and glare shield can be provided. Designed for concentrating light in stores and factories for special displays or operations. The F. W. Wakefield Brass Co., Vermilion, Ohio.

WAKEFIELD PROJECTOR



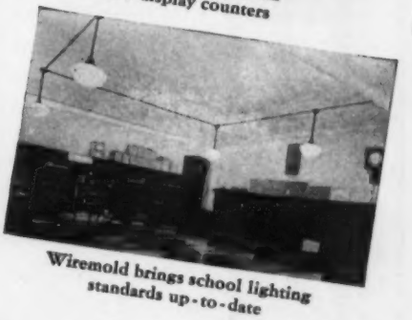
Factory Lighting with Wiremold Fluorescent Strip

Specifications that Tie right in with the ADEQUATE WIRING PROGRAM

Modern Kitchen Lighting with Wiremold Fluorescent Strip

Plugmold installation in store display counters

Wiremold sells better lighting in office buildings



Wiremold brings school lighting standards up-to-date

. . . and WIREMOLD backs you up with
SOUND PLANNING, SOUND ENGINEERING, SOUND SELLING

With Wiremold materials and methods you can write better and more profitable specifications for a majority of the domestic, commercial and industrial wiring and lighting jobs in your territory... You can go out after NEW business with Wiremold Fluorescent Strip, Lumiline and the Plugmold Multi-Outlet Assembly... You can tie right in with the Adequate Wiring Program, the Better Light Campaign. The wide open new opportunities in higher standards of factory lighting and wiring.

Find out NOW about the Wiremold Data Sheet Service and the constant selling help it gives you. Day in and day out Wiremold is your Business Builder.

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Conduit 3/8"—2 1/2"
Cable to 2 1/8" (with Bushings)

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Sizes from .250" O.D. Tubing to 1 1/4" conduit.

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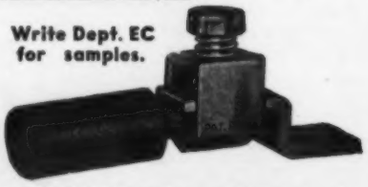
25 N. Peoria St., CHICAGO

PROOF

Here's proof you can depend on ILSCO Solderless Lugs to grip wires securely — against as much as 480 LBS. PULL!

Capacity of scale used in test: 500 lbs. Lugs used same size as shown below, for #8 to #4 wire range.

Write Dept. EC for samples.



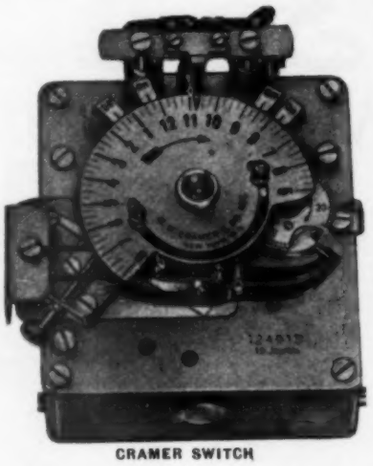
ILSCO COPPER TUBE & PRODUCTS, INC.
5629 Madison Road, Cincinnati, Ohio

EQUIPMENT News

[FROM PAGE 175]

Signal Control Switches

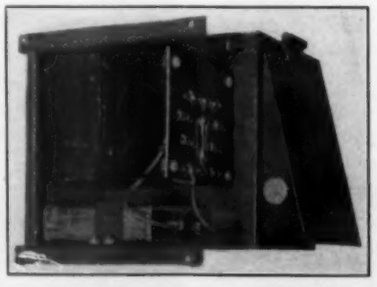
The Sauter signal control switches are for automatically closing a signal, alarm or other circuit for from 2 to 25 seconds duration, "on the hour" or half hour at various times throughout the day or night. For use by fire departments, factories, industrial plants, stores. Spring-driven electrically wound and hand wound switches, types SEC and SMC, are equipped with Sauter 13-jewel lever escapement, Breguet-Invar hair-spring and balance wheel, and a micrometer adjustment. For use on d.c. and also recommended for a.c. where power interruptions are frequent. R. W. Cramer & Company, Inc., 67 Irving Place, New York.



CRAMER SWITCH

Speed Controller

A multi-step speed controller for a.c. motors, making it possible to vary motor speed by changing input voltage. May be operated by a thermostat or automatic switch. Illustration shows principal components, an auto-transformer with voltage adjustment taps and oil filled condenser. Available for wall mounting, for mounting within a ventilated cabinet, or for mounting on motor itself. A movable link, or an enclosed multi-position tap switch can be furnished. Raytheon Manufacturing Co., Waltham, Mass.



RAYTHEON SPEED CONTROLLER

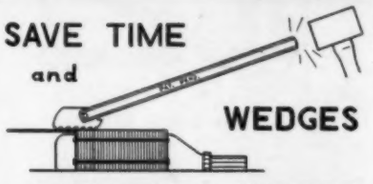
E-Z
Wire Stripper
saves time and money

Always ready — simple to use — protects wire and hands — cuts and strips instantly and automatically—faster than any other ordinary method. 2 sizes—No. 1 for wire No. 12 to 18. No. 2 for wire No. 10 to 16. Send for descriptive circular.

PYRAMID PRODUCTS CO.
2224 S. State St. Chicago, Ill.

YES ITS CO-OP
for
PRICE, QUALITY AND SERVICE ON STANDARD
ELECTRICAL SUPPLIES
Devices and Appliances
Lamps and Lighting
WHOLESALE SUPPLIERS
SINCE 1915
FREE CO-OP MONTHLY CATALOG
CO-OP ELECTRIC SUPPLY CO.
812 W. Jackson Blvd., Chicago, Ill.

SAVE TIME and WEDGES



with **PEM** WEDGE REMOVER

Drives 'em in too. Particularly handy in stators. Hardened 1/16" blade pivots conveniently. Soon saves many times its small cost of $1.75 (at dealers or postpaid from factory.) Add tax in Calif.

PACIFIC ELECTRO MECHANICAL CO.
1129 West 19th St., San Pedro, Calif.

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Have you invented a product which will do the job cheaper or better? Do you have a pet gadget that you'd like to make money on? If you have, here's your chance! We can help you develop, finance, manufacture, and sell it on a national basis. *Write us.*

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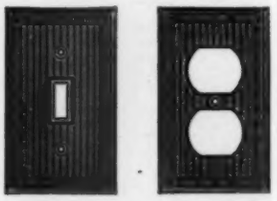
Dept. C—220 Church St.—New York City
National Sales Agents for
CLIFTON CONDUIT RATTAN FITTINGS
RITTENHOUSE CHIMES

Wall Plates

A new line of wall plates, known as Uniline, have a standard surface design and universal trade number. A choice of brown Bakelite or ivorylite. All regularly listed plates are now available in new standard Uniline design. Convenience of universal trade numbers will simplify all stock records. Arrow-Hart & Hegeman Electric Co., Hartford, Conn.



ARROW-HART & HEGEMAN WALL PLATES

■

Starter and Circuit Breaker

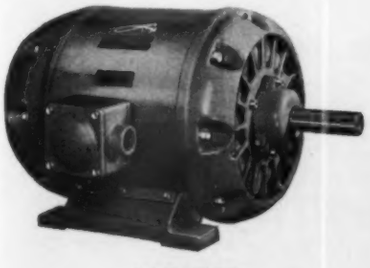
Combination magnetic starters and circuit breakers have been added to the Trumbull line of industrial control. Devices are available in range of 0–25 horse power control at 110-550 V.A.C. Trumbull Electric Mfg. Co., Plainville, Conn.

TRUMBULL COMBINATION

■

Explosion-Proof Motor

Type E explosion-proof motors, a new line for both alternating and direct current. Eighteen major mechanical and electrical improvements are incorporated in this line, designed to operate in plants where they manufacture or use or handle explosive materials. The Louis Allis Co., Milwaukee, Wis.



ALLIS MOTOR

All Adequate Specifications Should Include

DUTCH BRAND FRICTION TAPE

For its Extra Service Qualities!

You never pay for the fourth layer of rubber on DUTCH BRAND Friction Tape. It's this fourth layer that gives DUTCH BRAND many of its unusual qualities.

★ The fourth layer of rubber on DUTCH BRAND Friction Tape is that extra something that makes DUTCH BRAND so good. More rubber thoroughly impregnated into the fabric means longer life, tighter adhesion and insulating strength far greater than the usual 2 or 3 coat tape.

You pay nothing extra for the "Extra Service" qualities of DUTCH BRAND Friction Tape, the largest selling tape in the electrical trade. It's good because it's made better.

DUTCH BRAND Friction Tape, Rubber Tape and Soldering Paste are sold by electrical jobbers everywhere

★

The New Temper-Proof Jumbo Shop Package

Contains 10 standard No. 8 rolls. The economical way for repairmen, electrical contractors and industrial users to purchase Friction Tape where individually cartoned tape is not required.

Standard Packages—The Nos. 8, 4, 2 and 1 sizes are all available in the well known orange and blue individual and display cartons and metal counter dispensers for retail sale.

DUTCH BRAND Rubber Insulating Tape

Fuses instantly without heat. Molds into one solid piece. It s-t-r-e-t-c-h-e-s without breaking because it contains more live, new rubber. Approved by Underwriters' Laboratories.

VAN CLEEF BROS. Est. 1910
Manufacturers
WOODLAWN AVENUE, 77th to 78th STREETS, CHICAGO, U. S. A.

DUTCH BRAND *Friction Tape*

EXCEEDS THE QUALITY SPECIFICATIONS OF THE A. S. T. M.

1939 EDITION DIRECTORY of ELECTRICAL WHOLESALERS

JUST OFF THE PRESS

An essential sales guide for every electrical manufacturer, his branch offices and field representatives.

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Durably bound—stiff cloth covers—gold stamped

The WHOLESALER'S SALESMAN

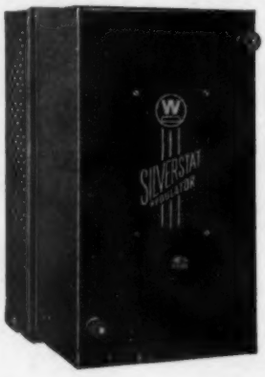
330 WEST 42nd ST. NEW YORK

EQUIPMENT NEWS

[FROM PAGE 177]

Voltage Regulator

A moderately priced regulator for automatic voltage control of small a.c. and d.c. generators. Direct and quick acting, rheostatic type. Varies directly the resistance in the field circuit. Regulator is completely enclosed by removable covers and arranged for surface mounting with four bolts. Requires six connections for a.c. and four connections for d.c. application. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

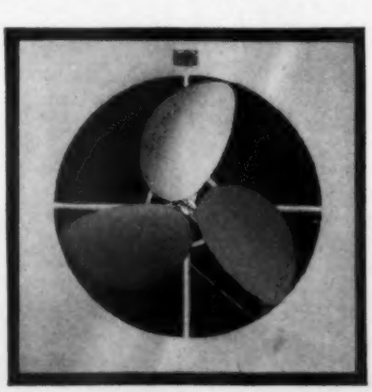


WESTINGHOUSE SILVERSTAT REGULATOR

■

Attic Ventilating Fan

The Coolvent line of attic ventilating fans feature compact and sturdy construction coupled with quiet operation. Made in 24-in. to 54-in. fan sizes and with a motor range from ⅛ to ¾ h.p., all ratings are certified for air delivery under NAFM test codes. These units employ a square steel plate panel, welded steel tubing supporting arms, and two self-aligning ball bearings mounted in flanged type rubber pillow blocks. The motor mounting bracket is designed to minimize vibration and placed off-center for easy belt tension adjustment. Fans are of three-blade design and operate at slow speeds from 281 to 577 rpm. according to wheel diameters. Autovent Fan & Blower Co., 1805 N. Kostner Ave., Chicago, Ill.



AUTOVENT COOLVENT FAN

MILLER FLUORESCENT UNITS

Fluorescent Counter Units

These fluorescent daylight counter units for color-matching are available in two styles, simple and deluxe. The simple style is finished in polished chrome combined with crackled black. Deluxe is finished in Nuvon and polished chrome. A 7 foot cord with plug permits either style to be placed on counter or table. Toggle switch in back of unit enables clerks to operate it from behind counter. Operates on 15 watts. The Miller Company, Meriden, Conn.

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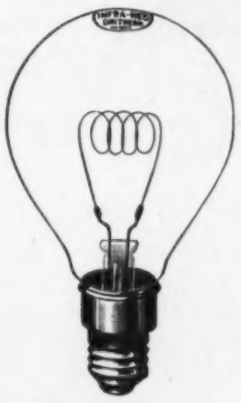


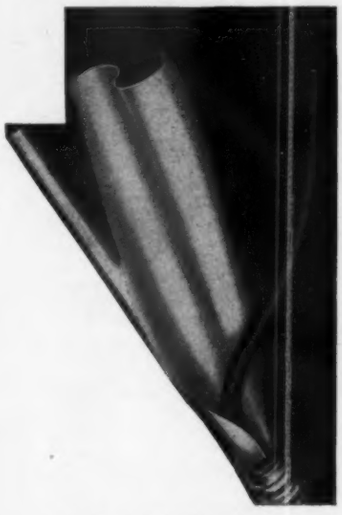
NORTH AMERICAN LAMP

Infra-Red Ray Lamp

The improved Nalco infra-red ray lamp, known as Dritherm, is for radiant drying and heating purposes. Long burning life obtained in proportion to high efficiencies. Uniformity of filament materials, as well as placement of carbon filament within the bulb gives rugged construction to minimize breakage. North American Electric Lamp Co., 1014 Tyler St., St. Louis, Mo.

Bushed Cable

A new armored cable, called G.E. Blue-Bushed BX, employs an S shaped paper wrap to increase the dielectric strength of the cable insulation to make it easier to use. In stuffing cable, when armor is removed, the bushing is inserted between paper and armor to protect the conductor where the armor ends. Conductors can then be untwisted and the paper torn off. The paper wrap also separates the conductors. General Electric Co., Bridgeport, Conn.



G.E. BLUE-BUSHED BX CABLE

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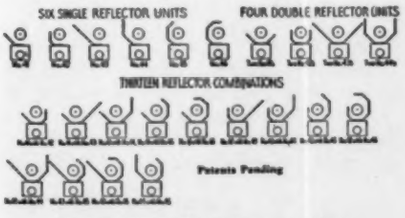
Fluorescent Reflectors

Wilson "combinational" reflectors for use with Wilson fluorescent wiring channel, provide 23 reflector shapes in four sizes for different lighting requirements. Reflectors may be used in pairs or in combinations of any number, mounted end to end to form a continuous reflecting surface or used in individual fixtures. Units come cut to correct size and punched ready to attach without cutting, drilling or fitting. Stock finish in aluminum alloy and Alcoa lighting sheet—usable with fluorescent mazda or lumiline lamps on 18 in., 24 in. and 36 in. centers. Provide wide diversity of light distribution. Reflectors of extra heavy gauge material for strength and rigidity, each the exact length of the lamp to make a tight joint through a reinforcing flange on the outer edge. Cover plates are removable without disturbing sockets. Wilson Lighting, Inc., 411 South Clinton St., Chicago.



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Has white diffusing glass globe with all white reflector. Globe is held by a MULTI "Gripit" holder with internal finger support. No breakage from vibration or expansion.

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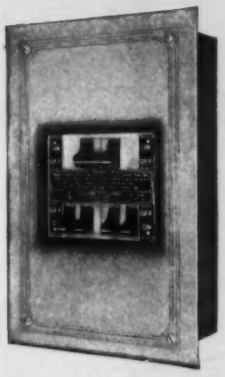
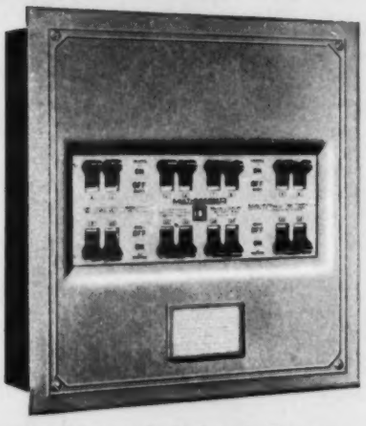
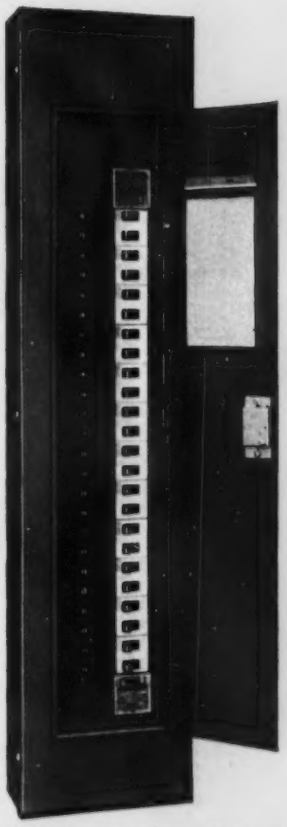


● For the medium-sized home. Service center up to six circuits; load center up to eight.



● Multi-breakeR Load Center. Branch circuit protection and switching up to sixteen circuits.



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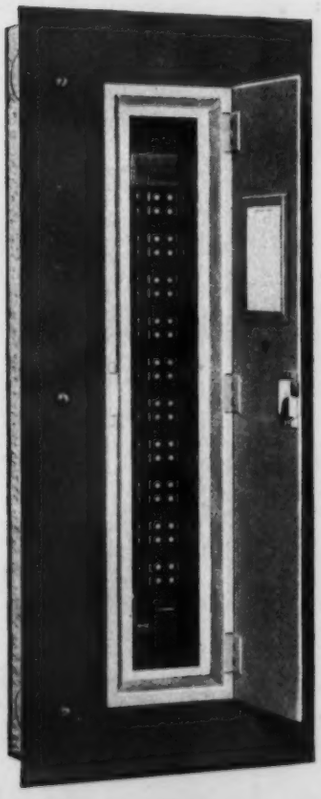

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For illustrations and descriptions of G-E Materials for every type of wiring]

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